臺北醫學大學 TAIPEI MEDICAL UNIVERSITY

臺北醫學大學 醫學工程學院 TMU BIOMEDICAL ENGINEERING

College of Biomedical Engineering
Taipei Medical University, Taiwan
Scientific Report 2020-2021

Taipei Medical University (TMU)

Taipei Medical University (TMU) is a collegiate academic institution with an extensive history in Taiwan.

Established in 1960, over the past half-century, TMU was able to grow under challenging circumstances without regular official financial support from the government or funding from foundations. It went through the challenges allowing to building the foundation, flourishing, expansion and transformation via innovation. Today, TMU has expanded into a world-class university with 11 colleges, 6,500 students per year, 6 hospitals (TMU Hospital, Wan Fang Medical Center, Shuang Ho Hospital, Taipei Cancer Center, TMU NingBo Medical Center and Neuromedical Center), and more than 40,000 alumni around the world, serving the society and humankind and also cultivating the future talents for the nation. These are TMU's most concrete contributions and most important responsibility and mission.

In July 2020, Global Views Monthly Magazine released the ranking for Taiwan's Best Universities in private University section, in which TMU was ranked 1st. In particular, TMU was ranked top 1 in both faculty-student ratio section and average annual budget per student section. In 2020. Cheers Magazine published the list of the Top 20 Universities of Excellence Performance:TMU was at the 9th place in overall national ranking. Moreover, according to the Times Higher Education (THE) Asia University Ranking 2020, TMU was ranked as 35th place.

In the future, TMU's core of education lies in tradition and innovation. The strong foundations that TMU has established in internationalization of teaching and research, information management, translational research on cancer, neurodegenerative and medical humanities will be passed down. Areas for innovation include interdisciplinary education, biotechnology entrepreneurship, neurology and caring industry.

Dean's Message

The College of Biomedical Engineering is one of the newest addition to the 60-year-old Taipei Medical University with a creation in August, 2015. CBME is dedicated to cultivate new generation work force for biotechnology industry with both sound biomedical engineering education and internship programs in the 6 TMU-affiliated hospitals.

We wish to build in thinking processes of engineers and medical professionals in our students so that they may be able to serve in the healthcare and biotechnology industry with an understanding of clinical needs. CBME features globalization, clinical translation, and industrial collaboration for a multidisciplinary task force to promote welfare of human beings. With these training programs, we expect students to become competitive and productive talents in all branches of biomedical engineering industry.

Biomedical technology is the flagship in Taiwan's economy development roadmap. Taiwan Society of Biomedical Engineering is actively formulating a board certification mechanism for biomedical engineers. Meanwhile, market for medical devices for the aged and the handicapped will explosively expand as the local and global society is rapidly aging. We envision the convergence of both trends will create urgent needs for engineers with solid medical exposure experiences. CBME hosts SBME, GIBMTE, GINME, GIBOM and IPBME institutes to accommodate domestic and international undergraduates, master, PhD and postdoctoral trainees. We hope the diverse, clinical needs-centered research and educational environment will generate strong growth momentum for Taiwan's industry of biomedical technology and biomedical engineering research.

Sincerely

Chih-Hwa Chen
Professor and Dean
College of Biomedical Engineering
Taipei Medical University

Vice Dean's Message

Our College has the vocation and the motivation to become an “international hub” in the field of Biomedical Engineering research and teaching in the Asia-Pacific area, with multiple connections to the rest of the world. We are actively working in that direction, as revealed by numerous concrete actions that have taking place and already bearing fruits.

Our Graduate Institutes and the International Ph.D. Program in Biomedical Engineering are providing all their classes in English. Our undergraduate program is expanding continuously, and our students actively engaged in internships abroad, and mutual exchanges. We have established solid and concrete working relationships in various research fields with sister Universities in USA, France, Japan, Australia, and Sweden. We have research contracts with the local and international industries developing new biomedical technologies. The number of foreign students from Asia, Africa, Central America applying and joining CBME is increasing on a yearly basis to over 50% for Ph.D., and close to 25% at the Graduate level. The proportion of scientific publications with foreign laboratories, that reflects our active collaborations with international teams, is steadily increasing on a yearly basis and will continue to do so in the near future. This is illustrated by the always-increasing quality of CBME scientific publications in top-quality journals in the field of biomedical engineering and life sciences, as well as by the progress we are seeing in the international academic ranking of our college. We have recruited two additional professors who can expand our international frontiers, enrich our research and teaching capacity, and stimulate our international developments.

Through continuous efforts, through the unique links our university has with its affiliated hospitals, and its location in the dynamic and friendly environment of Taiwan, our College has all the potential to develop into a successful biomedical engineering spotlight. We are all striving for it.

Sincerely

Thierry Burnouf
Distinguished Professor and Vice Dean
College of Biomedical Engineering
Taipei Medical University

Vice Dean's Message

College of Biomedical Engineering (CBME) draws from core disciplines such as clinical engineering, basic sciences, bio-design, nanotechnology, biomaterials, and tissue engineering emphasizing an interdisciplinary approach to research and education.

The goal of CBME is dedicated to solving clinical needs through advanced biomedical engineering technology and toward translational commercialization. CBME actively coordinates and interfaces with other departments, research centers and TMU-affiliated hospitals to facilitate biomedical engineering opportunities in areas such as bioengineering, biotechnology, medical AI, biomaterials, assistive devices, wearable technology, drug delivery, and medical devices. We have established research laboratories and clinical trial centers in the affiliated TMU teaching hospitals to streamline clinical applications in the area of diagnosis, therapeutics, medicine, nanotechnology, and public health fields. Through cooperating with the industry-university-research platform of pre-clinical study in the development of medical device, and provides the co-operation/co-development services, CBME could create a mini innovative ecosystem across disciplines and enable the faculty to achieve multiple effects based on their research achievements and educate students to be contributors to medical science and nanotechnology with global vision.

Sincerely

Jen-Chang Yang
Professor and Vice Dean
College of Biomedical Engineering
Taipei Medical University

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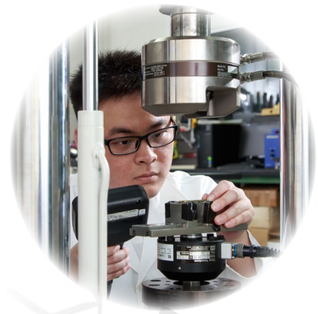
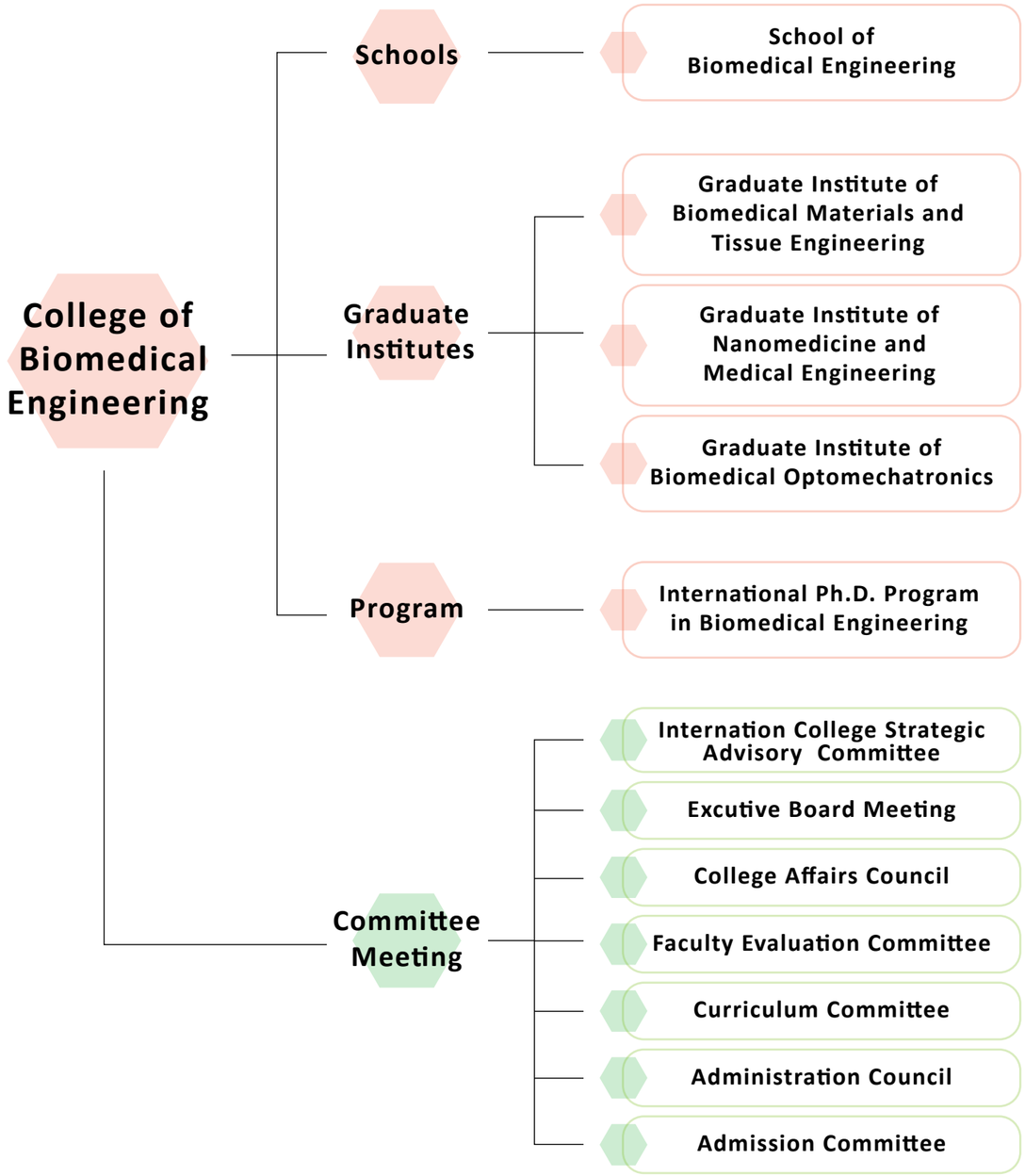


ORGANIZATION CHART



SCHOOL, GRADUATE INSTITUTES, AND PROGRAM

School of Biomedical Engineering

Graduate Institute of Biomedical Materials and Tissue Engineering

Graduate Institute of Nanomedicine and Medical Engineering

Graduate Institute of Biomedical Optomechatronics

International PhD Program in Biomedical Engineering

SCHOOL OF BIOMEDICAL ENGINEERING

About

The School of Biomedical Engineering (SBME) was newly established in August 2016. SBME aspires to be a first-rated and leading BME-school worldwide. SBME offers student a high-quality, medical- driven learning environment with excellence in undergraduate education. Students will acquire basic ability to use mathematics, chemistry, engineering, biological, physics and medical knowledge. We encourage students to explore medical problems and unmet clinic needs. We stress the need for students to develop their ability to design, execute experiments, analyze and interpret data, and solve these problems. Students have a unique opportunity to understand and get familiar with the means to apply advanced technology to the complex problems of clinical medicine. We emphasize a clinically-oriented education to prepare students to excel as professionals in biomedical engineering. We expect students to contribute to the academic and industrial development of biomedical engineering.

Chih-Wei Peng, Ph.D.
Chairman

Eligibility

1. Admissions
   - General Category
   - Foreign Category
   - Special Talents (e.g. Design, Protyping, etc.)
2. Entrance Test

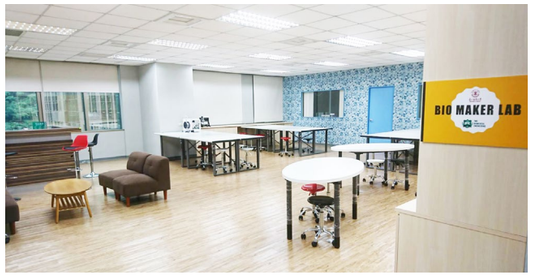
Missions

1. Enhance students' basic knowledge and professional skills in biomedical engineering and have the competence to integrate multidisciplinary technologies.
2. Educate student to comprehensively specialize in the field of biomedical engineering by hands-on and clinic problem-based oriented teaching approaches.
3. Foster student with humanities and noble character for the promotion of social care and social well-being.
4. Nurture student to be an innovative biomedical engineer with prospective and international vision.

Requirement for B.S. Degree

The BS degree in biomedical engineering requires 130 credits.

- Required (70 credits)
- Selective (32 credits)
  - A. Track of Medical Mechanics & Materials
  - B. Track of Bio-optomechatronics
- Humanities and Social Sciences (28 credits)



Major Publications

1. Chen SC, Chu PY, Hsieh TH, Li YT, Peng CW. Feasibility of Deep Brain Stimulation for Controlling the Lower Urinary Tract Functions: An Animal Study. Clinical Neurophysiology, 2017 ; 128:2438-2449.
2. Liou JC, Chang YT .Inves tigated of the Reproducibility of Upper-Limb Motor Function in Stroke Patients. Journal of Nanoelectronics and Optoelectronics .2017 ;12: 862-867.
3. Chen YJ, Kuo KK, Ting LL, Lu LS, Lu YC, Cheng AJ, Lin YT, Chen CH, Tsai JT, Chiou JF. Piperlongumine inhibits cancer stem cell properties and regulates multiple malignant phenotypes in oral cancer. Oncology Letters 2018 ;15:1789-1789.
4. Chung PS, Fan YJ, et al., Real-time dual-loop electric current measurement for label-free nanofluidic preconcentration chip .Lab on a Chip. 2015 ;15: 319-330
5. Liu HS, Shen H, Luo Y, Hoffer BJ, Wang Y, Yang Y. Post-treatment with Cocaine- and Amphetamine-regulated Transcript Enhances Infarct Resolution, Reinnervation and Angiogenesis in Stroke Rats - A Magnetic Resonance Imaging Study. NMR Biomed. 2016; 29: 361–370.

Staff and Contact Information

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GRADUATE INTITUTE OF BIOMEDICAL MATERIALS & TISSUE ENGINEERING

About

The Graduate Institute of Biomedical Materials and Tissue Engineering (GIBMTE) was established in 2006 under the College of Oral Medicine. This institute was moved to the newly College of Biomedical Engineering, which was set up in 2015 reflecting the broad scope of BMTE in biomedical and therapeutic fields. We offer both Master and PhD degrees in Sciences, as well as dual diploma with Universities in Europe, Japan, USA, etc. GIBMTE provides an international, multidisciplinary teaching courses, also equipped with various kinds of instruments to offer a good research environment to educate students with basic /advanced knowledge in the field of biomedical materials, tissue engineering, and cell-based regenerative medicine. Our connections with the TMU system of hospitals provide students chance to work with clinics inspiring critical thinking and novel findings. A special program of fellowships is also available to support foreign students to become an excellent researchers/leaders in the field of BMTE.

Ching-Li Tseng, Ph.D.
Director

Eligibility

1. Domestic and foreign students
2. MS applicants: Hold a Bachelor degree in science/engineering, related to biomedical engineering (biology, biotechnology, pharmacy, medicine, chemistry, biomedical engineering, chemical engineering, material engineering, electrical engineering etc.)
3. PhD applicants: Hold (a) a MS in science/engineering, related to biomedical engineering (biology, biotechnology, pharmacy, medicine, chemistry, biomedical engineering, chemical engineering, material engineering, electrical engineering etc.), or (b) a MD degree and least two years of documented clinical training with publication(s) equivalent to a MS thesis

Missions

1. Broaden the vision and experience of MS students in the field of biomedical engineering, and meet the expectations of global research. Establish the knowledge, skills and confidence of students to serve in biomedical/biotech company, or hospitals, or to pursue further study in PhD program.
2. Training doctoral candidates with critical thinking, creativity, and wisdom to become an independent researcher, conduct post-doctoral fellow studies, then become faculty in University, principle investigator in academic institute, or manager in biomedical and biotech company.

Master Degree Requirements (2 Years)

- 26 credits in Required Courses (including 6 credits for MS Thesis) and 4 credits in Elective courses
- Research Ethics (no credit)
- Thesis
- Pass oral thesis defense

Staff and Contact Information

Ching-Li Tseng, Ph.D., Associate Professor and Director
Erin Huang, Secretary

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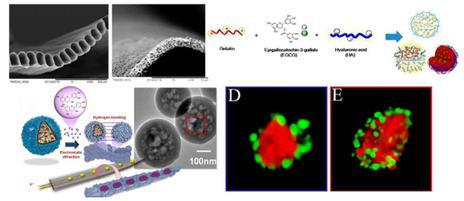
URL: https://www.facebook.com/GIBMTE/

Representative Figures



PhD Degree Requirements (3-4 Years)

- 26 credits in Required Courses (including 12 credits for PhD Thesis) and 4 credits in Elective courses Research Ethics (no credit)
- Present an oral PhD progress report each year, one being considered as Qualification Examination, making the candidate eligible for PhD thesis presentation.
- SCI Publication as first author with total cumulative impact factor ≥ 5
- PhD dissertation and Pass oral dissertation defense.

Major publications

1. NT Trang, VT Pham, MK Doan, AT Hoang, LS Lu. Study of The Expression of Programmed Death Ligand 1 (PD-L1) on Non-small Cell Lung Cancers (NSCLCs) at Bach Mai Hospital, Vietnam. Journal of Clinical Oncology, 2019; 37(15): pp. e13107.
2. K Schallmoser, R Henschler, C Gabriel, MBC Koh, T Burnouf. Production and Quality Requirements of Human Platelet Lysate: A Position Statement from the Working Party on Cellular Therapies of the International Society of Blood Transfusion. Trends Biotechnol, 2020; 38(1): 13-23.
3. DJ Lundy, KJ Lee, IC Peng, CH Hsu, JH Lin, KH Chen, YW Tien, PCH Hsieh. Inducing a Transient Increase in Blood-Brain Barrier Permeability for Improved Liposomal Drug Therapy of Glioblastoma Multiforme. ACS Nano, 2019; 13(1): 97–113.
4. CW Chiang and EY Chuang. Biofunctional core-shell polypyrrole–polyethylenimine nanocomplex for a locally sustained photothermal with reactive oxygen species enhanced therapeutic effect against lung cancer. Int J Nanomedicine, 2019; 14: 1575–1585.
5. YL Chuang, HW Fang, A Ajitsari, KH Chen, CY Su,GS Liu, CL Tseng. Development of Kaempferol-Loaded Gelatin Nanoparticles for the Treatment of Corneal Neo-vascularization in Mice. Pharmaceutics, 2019; 11(635): 1-16.
6. CH Tseng, WT Huang, CH Chew, JK Lai, SH Tu, PL Wei, KY Lee, GM Lai, CC Chen. Electrospun Polylactic Acid (PLLA) Microtube Array Membrane (MTAM)-An Advanced Substrate for Anticancer Drug Screening. Material, 2019(12):569-581.
7. FC Chao, MH Wu, LC Chen, HL Lin, DZ Liu, HO Ho, MT Sheu. Preparation and Characterization of Chemically TEMPO-oxidized and Mechanically Disintegrated Sacchachitin Nanofibers (SCNF) for Enhanced Diabetic Wound Healing. Carbohydr Polym, 2020; 229:115507.
8. GR You, AJ Cheng, LiY Lee, YC Huang, H Liu, YJ Chen, JT Chang. Prognostic Signature Associated With Radioresistance in Head and Neck Cancer via Transcriptomic and Bioinformatic Analyses. BMC Cancer, 2019; 19(1): 64.

GRADUATE INSTITUTE OF NANOMEDICINE AND MEDICAL ENGINEERING

About

Graduate Institute of Nanomedicine and Medical Engineering (GINME) has been established to focus on translational research for addressing clinical needs through innovations and advances in nanotechnologies. Nanomaterials for medical device and drug delivery as well as the nanotechnology based diagnostics are two major focused areas of GINME. The implementation of nanomaterials into medical device applications and long-term translational research toward clinical trials are our main tasks.
For the course design, we focus on the connection of nanomaterials and clinical applications. Each student has two advisors included one basic research professor and one clinical doctor. GINME is also an internationally-oriented institute, implementing dual degree programs, scholar exchange programs and research collaborations in association with leading institutes. We aim to establish an internationally visible program known for research excellence and track record in nano-product incubation.

Jen-Chang Yang, Ph.D.
Director

Major Achievements

In GINME, students will learn how to apply electrical, electronics and systems engineering in medicine and biology, and also gain experience in developing and using new technologies, including medical, instrumentation and prosthetic devices, and discover the properties of materials used in the formation of these medical devices such as caries prevention and ENT hemostasis.

The Missions of GINME Are:

Advanced and spread knowledge for students in the area of health, medicine, and nanotechnology.

1. Provide students opportunities as visitors and interns in affiliated hospitals.
2. Educate students to be contributors to medical science and nanotechnology.
3. Integrate research resources and lectures to improve students' skills, performance, and global vision.

GINME Highlights:

1. Dual degree program with Tokyo University of Science (TUS)
2. Two tracks: (1) Innovations in Nano/Biomedical Materials and (2) Nanotechnology Applied in Medical Diagnosis and Therapy
3. Dual advisors: (1) one basic research professor and (2) one clinical doctor

Career Opportunities After Graduation

Our graduates will be eligible to attend board certification examinations for biomedical engineers, and may develop a career in biotechnology, pharmaceutics, cosmetics, material science, healthcare, public service, and research faculty in universities.

GINME Has Ten Core Research Fields Including:

1. Medical devices toward preventive and the minimally invasive applications.
2. Electrospun silk polymers for biomimetic researches.
3. Biological applications of porous silica nano-platform.
4. Catcher in the Rel protein: Nanoparticles-antibody conjugate as NF-κB nuclear translocation blocker.
5. Impacts of protein corona on biological effects of mesoporous silica nanoparticles.
6. Peptide-mediated delivery of pH-sensing mesoporous silica nanoparticles into lysosome in living cells.
7. Screening and harnessing stem cell behavior.
8. Gold nanoclusters as a fluorescent probe for assessment of cancer progression.
9. SERS substrate for detection of disease biomarkers.
10. Flexible and wearable devices for point-of-care tests (POCT)

Staff and Contact Information

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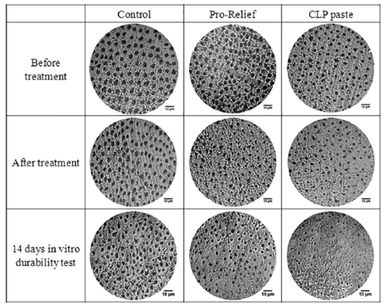
Representative Figures

1.



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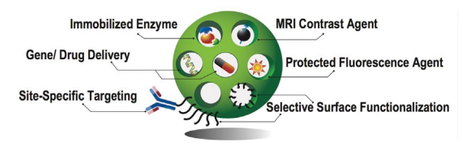

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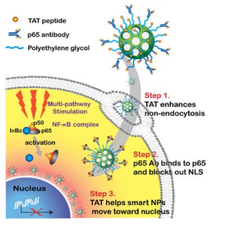

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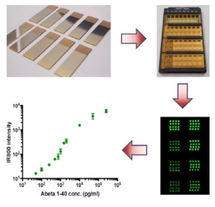

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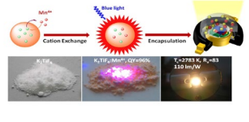
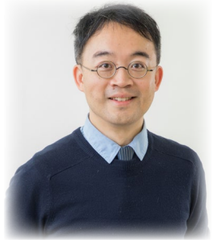


1. The optical micrographs of occlusal dentin disk surface pre-treatment, immediately post-treatment, and 14-day post-treatment of various desensitizing pastes.
2. Biological applications of porous silica nano-platform.
3. Catcher in the Rel: Nanoparticles-antibody conjugate as NF-κB nuclear translocation blocker.
4. SERS platform for biomarker detection
5. Flexible and stretchable bioelectronic devices integrated with nanomaterials.
6. Synthesis, analysis and device package of the luminescent materials.

GRADUATE INSTITUTE OF BIOMEDICAL OPTOMECHATRONICS

About

The aims of GIBOM are to integrate optical, electronic, mechanic, and materials fields in order to develop bio-medical instruments for use in life sciences and clinical medicine. We offer Master degree in Sciences, as well as dual diploma with Universities in Europe, Japan, USA, etc. The students in GIBOM will be trained with a broad, flexible, inter-disciplinary, and international education which is rooted in engineering, biological sciences, and medicine. GIBOM has two main training components. One is medical optoelectronic and mechatronic engineering which focus on pursuing innovative and impactful research of diagnostic sensors. The second one is biological response to physical stimulation which aims to develop a medical device for precision medicine. The course arrangement at GIBOM is suitable for the biology and medical students as well as for engineering students who want to specialize in biomedicine.



Tzu-Sen Yang, Ph.D.
Director

Eligibility

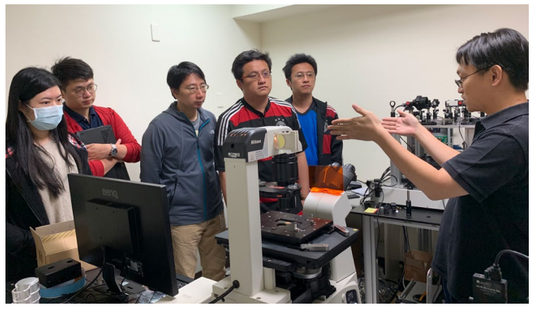
1. Taiwanese and foreign students
2. MS applicants: Hold a Bachelor degree in science, related to biomedicine or engineering (biology, pharmacy, medicine, mechanical engineering, electronic engineering, chemical engineering, material science etc.)

Missions

1. GIBOM will connect mature local electronics and optoelectronic industries to leverage quickly with companies developing and manufacturing products with advanced biomedical-optomechatronics-related technologies.
2. GIBOM aims to incubate interdisciplinary experts who are able to integrate various sciences and engineering techniques and can develop novel instrumentation necessary for modern medical treatment and disease prevention.

Master Degree Requirements (2 Years)

- 26 and 4 credits in Required (including 6 credits for MS Thesis) and Elective courses, respectively.
- Research Ethics (no credit)
- Thesis
- Pass oral thesis defense



Staff and Contact Information

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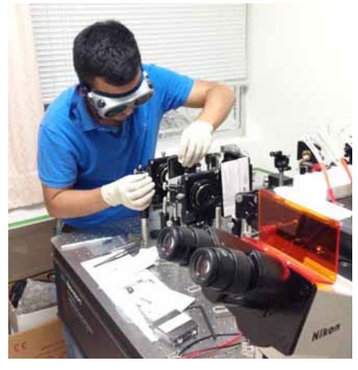
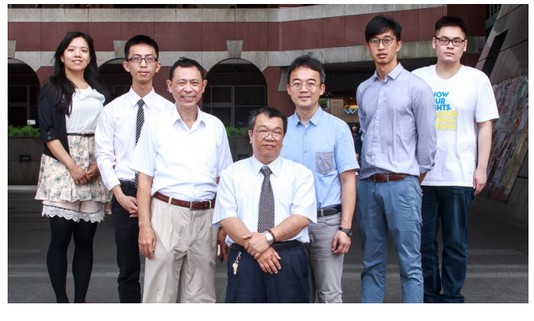
https://www.facebook.com/TMUGIBOM/

Major Publications

1. Yen HC, Kuo TR, Wang CT, Lin JD, Chen CC, Hsiao YC. Optical Properties of Electrically Active Gold Nanoisland Films Enabled with Interfaced Liquid Crystals. Nanomaterials 2020: 10, 290-297.
2. Huang, CF, Colley MMS,;Lu LS, Chang CY, Peng PW, Yang TS. Performance characterization of continuous-wave laser-induced forward transfer of liquid bioink. Appl. Phys. Express. 2019; 12: 116504-116508.
3. Manga YB, Ko FS, Yang YS, Hung JY, Yang WL, Huang HM, Wu CC. Ultra-fast and sensitive silicon nanobelt field-effect transistor for high-throughput screening of alpha-fetoprotein. Sensors & Actuators: B. Chemical 2018;256:1114-1121
4. Lew WZ, Huang YC, Huang KY, Lin CT, Tsai MT, Huang HM. Static magnetic fields enhance dental pulp stem cell proliferation by activating the p38 mitogen-activated protein kinase pathway as its putative mechanism. Journal of Tissue Engineering and Regenerative Medicine. 2018;12:19-29.





INTERNATIONAL PhD PROGRAM IN BIOMEDICAL ENGINEERING

About

The International PhD Program in Biomedical Engineering (IPBME) was created in 2016 under the newly established College of Biomedical Engineering of TMU. All professors of the College of Biomedical Engineering belong to IPBME, thereby offering to Foreign PhD students a unique opportunity to develop and apply their skills in the multidisciplinary sciences of biomedical engineering. The students can conduct their PhD degrees as a dual diploma with Universities in Europe, Japan, USA, etc. Our mentoring system is also unique by allowing students to have one overseas collaborating professor and by strongly supporting overseas research collaborations. Our teaching and research environment is truly stimulating to students interested in biomedical materials, tissue engineering, nanotechnologies and nanomedicine, and/or bio-optomechatronics. The close links existing with the TMU group of hospitals constitute a strong incentive to students to test, evaluate and apply their research ideas for most successful translational medicine applications. International students enrolled in this program can receive fellowships, helping them to pursue their professional or academic dreams. Pursuing a PhD degree within IPBME truly represents an excellent opportunity in career development in safe and hospitable Taiwan, while being an "eye-opener" on how biomedical engineering is changing the quality and accuracy of treatment of patients worldwide.

Thierry Burnouf , Ph.D.
Director

Eligibility

1. Foreign students
2. Degree: Hold (a) a MS in science, related to biomedical engineering (biology, pharmacy, medicine, biomedical engineering, chemical engineering, etc.), or (b) a MD degree and least two years of documented clinical training with publication(s) equivalent to a MS thesis.

Missions

1. Be an actor of the developments of biomedical engineering worldwide and Asia.
2. Provide the intellectual knowledge and creative capacity to pursue postdoctoral studies or an academic or industrial career in biomedical and biotech industry.
3. Share critical thinking, creativity, and intellectual independence to foster leadership in biomedical engineering and science.

PhD Degree Requirements (3-4 Years)

- Share critical thinking, creativity, and intellectual independence to foster leadership in biomedical engineering and science.
- 4 credits in Elective courses
- Research Ethics (no credit)
- Present an oral PhD progress report each year, one being considered as Qualification Examination, making the candidate eligible for PhD thesis presentation
- SCI Publication(s) as first author in a journal in the top 30% of its category or with total cumulative impact factor≧5
- PhD dissertation
- Pass oral dissertation defense

the IPBM research focus

Major Publications

1. Fan, YJ Huang, MZ Hsiao, YC Huang, YW Deng, CZ Yeh, C Husain, RA Lin, ZH. Enhancing the sensitivity of portable biosensors based on self-powered ion concentration polarization and electrical kinetic trapping. Nano Energy, 2020. (69): -. (IF: 15.548)
2. Agrahari, V Burnouf, PA Burnouf, T Agrahari, V. Nanoformulation properties, characterization, and behavior in complex biological matrices: Challenges and opportunities for brain-targeted drug updates delivery applications and enhanced translational potential. Advanced Drug Delivery Reviews, 2019. (148): 146-180. (IF: 15.519)
3. Renn, TY Huang, YK Feng, SW Wang, HW Lee, WF Lin, CT Burnouf , T Chen, LY Kao, PF Chang, HM. Prophylactic supplement with melatonin successfully suppresses the pathogenesis of periodontitis through normalizing RANKL/OPG ratio and depressing the TLR4/MyD88 signaling pathway. Journal of Pineal Research, 2018. (64): -. (IF: 15.221)
4. Agrahari, V Agrahari, V Burnouf, PA Chew, CH Burnouf, T. Extracellular Microvesicles as New Industrial Therapeutic Frontiers. Trends in Biotechnology, 2019. (37): 707-729. (IF: 13.747)
5. Schallmoser, K Henschler, R Gabriel, C Koh, MBC Burnouf, T. Production and Quality Requirements of Human Platelet Lysate: A Position Statement from the Working Party on Cellular Therapies of the International Society of Blood Transfusion. Trends in Biotechnology, 2020. (38): 13-23. (IF: 13.747)
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10. Kuo, TR Liao, HJ Chen, YT Wei, CY Chang, CC Chen, YC Chang, YH Lin, JC Lee, YC Wen, CY Li, SS Lin, KH Wang, DY. Extended visible to near-infrared harvesting of earth-abundant FeS2-TiO2 heterostructures for highly active photocatalytic hydrogen evolution. Green Chemistry, 2018. (20): 1640-1647. (IF: 9.405)

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TMU BIOMEDICAL ENGINEERING RESEARCH

Chih-Hwa Chen : Bone & Joint
Hsiang-Ho Chen : Medical Devices
Chih-Wei Peng: Neural Engineering Assistive Technology (NEAT)
Jian-Chiun Liou: Nano Bioengineering and Bio-ASIC Chip
Hua-Shan Liu : Magnetic Resonance Imaging Technique
Yu-Jui (Ray) Fan : Total Analysis System on Tissue and Cell (FanTASTiC)
Thierry Burnouf : Platelet Biomaterials
Der-Zen Liu : Liposomal Vaccine
Chien-Chung Chen : Microtube Array Membrane (MTAM)
Ching-Li Tseng : Biomaterial Design For Drug Delivery, Tissue Regeneration- Ophthalmology
Er-Yuan Chuang : Drug Delivery
Yin-Ju Chen : Cancer Translational Research Laboratory
Long-Sheng Lu : Translational Radiation Biology
David J. Lundy : Drug delivery, nanomedicine and tissue engineering
Jen-Chang Yang : Dental Materials & Medical Devices
Yi-Ping Chen : Nano Theranostic
Tsung-Rong Kuo : Nanomaterials & Nanotechnology
Si-Han Wu : Hybrid Silica
Haw-Ming Huang: Bioelectromagnetics and Related Material
Li-Chern Pan : Microfluidic Biochips
Tzu-Sen Yang : Molecular Dynamics
Yu-Cheng Hsiao : Photonics & Soft Matters
David William Green : Biomimetics and Bioinspired Engineering

CHIH-HWA CHEN : BONE AND JOINT RESEARCH TEAM

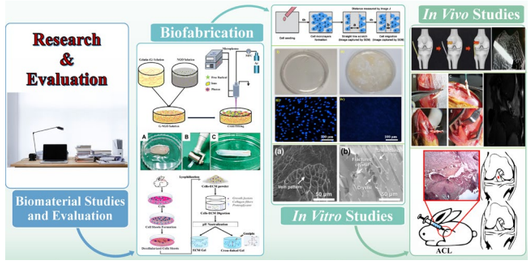
Chih-Hwa Chen, M.D., MBA
Professor

Major Research Aims

Under the leadership of Chih-Hwa Chen, M.D., MBA, an orthopedic surgeon at the Department of Orthopedic Surgery, Taipei Medical University Hospitals, and also a Professor at the College of Medicine, and Dean at the College of Biomedical Engineering, Taipei Medical University. Dr. Chen held several positions and directories in the past and currently, such as the Committee of the International Symposiums of Ligament and Tendon since 2002, currently the President of the Asia-Pacific Knee, Arthroscopy and Sports Medicine Society (APKASS), and a committee member of the Knee: Sports & Preservation Committee of the International Society of Arthroscopy, Knee Surgery and Orthopedic Sports Medicine (ISAKOS). An Emeritus President of the Taiwan Arthroscopy and Knee Society, and the Taiwan Shoulder and Elbow Society. He also holds memberships in several international and national orthopedic and related research organizations and sits on the editorial boards of several journals.
Under his leadership, the Research Team is making tremendous progress and focus on improving biomedical research condition and results, leading in tissue engineering, knee, shoulder, and degenerative joint diseases. Research on tendon-to-bone healing, cartilage tissue regeneration, bioengineering using different biomaterials – hydrogel, cell sheet, cell types, bioglass, and exploring novel strategies for rapid healing are core values and innovative approaches for the research team.

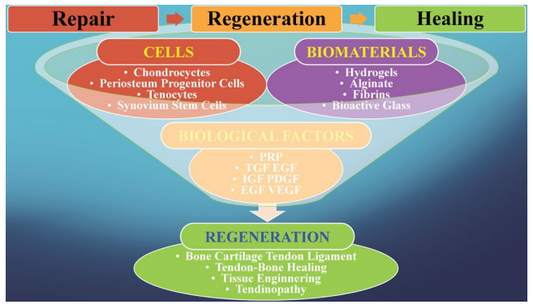
Major Achievements

1. Graphene oxide hydrogel crosslinking for reconstructive surgery by Nonthermal Microplasma.
2. Periosteum bone enhancement and fibrocartilage in-growth into interface zone of tendon-bone.
3. Successful fabrication of PPC-BMP-2 hydrogel to enhance tendon-bone healing through fibrocartilage.
4. Bioengineered PPC sheets through tissue engineering.
5. Periosteum-enveloping hamstring tendon grafting in single-bundle ACL reconstruction with minimal tunnel widening.



1. The research team is encouraged to study and evaluate relevant sources for excellent research findings.
2. Biofabrication – nonthermal microplasma, platelet-rich fibrin (PRF) patch preparation, and extracellular matrix (ECM) preparation.
3. *In vitro* – successful cell seedings and analyzed by ImageJ for cells sizes, cell-sheets characterization, SEM bio-glass evaluation.
4. *In vivo* – femur tendon-bone interference fixation, PRF augmented tendon-bone healing, ACL partial tear healing.

Representative Figures



1. Integrating research through repair – regeneration – healing. Focus on reconstruction targeting cell groups – from a clinical application point of view supporting tendon-bone healing.
2. Biomaterial appraisal in term of fibrocartilage formation in the interface between tendon and bone supporting a strong anchorage strength to improve the tendon-bone healing.
3. Biological factors supporting growth factors, cytokines, extracellular matrix molecules, cell surface molecules, and nucleic acids which are of significantly innovative importance for tendon-bone healing.
4. Regeneration study supporting an overall innovative in biomaterials – orthopedics, tissue engineering and bioengineering for bone, cartilage, tendon-bone healing after sports injury, and development of novel biomedical materials and devices for orthopedics applications.

Major Publications

1. Wong PC, Song SM, Tsai PH, Nien YY, Jang JS, Cheng CK, Chen CH. Relationship between the surface roughness of biodegradable mg-based bulk metallic glass and the osteogenetic ability of mg63 osteoblast-like cells. Mater. 2020 13(5):1188.
2. Song SM, Wong PC, Chiang CW, Tsai PH, Jang JS, Chen CH. A bi-phase core-shell structure of Mg-based bulk metallic glass for application in orthopedic fixation implants. Mater. Sci. Eng. C. 2020 26:110783.
3. Satapathy MK, Manga YB, Ostrikov KK, Chiang WH, Pandey A, Nyambat B, Chuang EY, Chen CH. Microplasma crosslinked graphene oxide-gelatin hydrogel for cartilage reconstructive surgery. ACS Appl. Mater. Interfaces 2019; 12(1):86-95.
4. Wong CC, Wong PC, Tsai PH, Jang JS, Cheng CK, Chen HH, Chen CH. Biocompatibility and osteogenic capacity of Mg-Zn-Ca Bulk metallic glass for rabbit tendon-bone interference fixation. Int. J. Mol. Sci. 2019; 20(9):2191.
5. Nyambat B, Chen CH, Wong PC, Chiang CW, Satapathy MK, Chuang EY. Genipin-crosslinked adipose stem cell-derived extracellular matrix-nano graphene oxide composite sponge for skin tissue engineering. J Mater Chem B. 2018; 6(6):979-90.

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HSIANG-HO CHEN : TISSUE BIOMECHANICS

Hsiang-Ho Chen, Ph.D.,
Professor

Major Research Aims

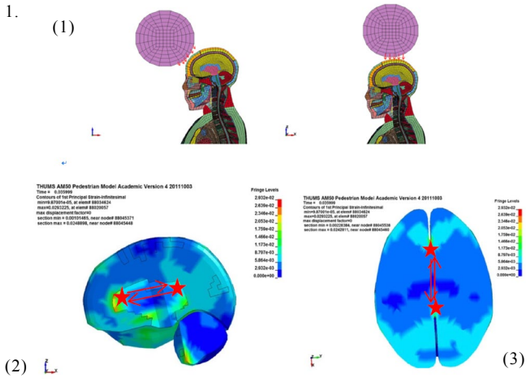
To develop better medical devices, our team utilizes useful tools in biomechanical evaluation. Viscoelastic properties at bone-implant interface were evaluated by measuring the implant stability quotient using resonance frequency analysis and by measuring the Periotest values using the Periotest device. The bone/implant specimens were evaluated histopathologically and histomorphometrically to determine the degree of osseointegration. Evaluation of viscoelastic properties at bone-implant interface and are reliable for indirectly predicting the degree of osseointegration. This effort has set up an evaluation system for future development of dental implants.
The other methodology is the numerical simulation of mechanical responses. In prevention of sports injury, model-predicted strain and strain rate in the corpus callosum correlating with changes in indices of concussion's white matter integrity have been confirmed preliminarily. Our study estimates the response of the human brain to soccer-heading impacts using the finite element method. It can help us understand the risk of concussion during heading, and design efficient protection devices.

Major Achievements

1. Finite element to investigate brain responses to soccer-heading impacts.
2. Biomechanical comparison of axial load between cannulated locking screws and noncannulated cortical locking screws.
3. Bone remodeling characteristics of a short-stemmed total hip replacement.
4. Ultrastructure of anterior cruciate ligament graft by atomic force microscopy.
5. Monitor the changes of viscoelastic properties at bone-implant interface via resonance frequency analysis

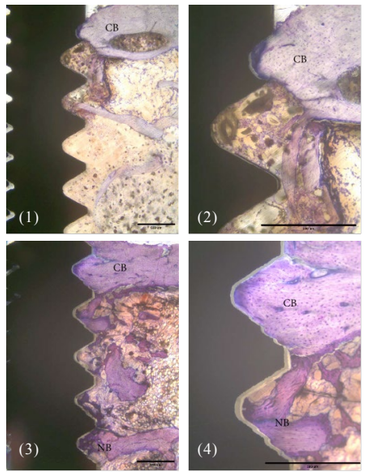
Representative Figures

1.



(1) Section view of the 3D model for simulation of forehead heading. (2) Strain distribution of the brain on the sagittal plane and (3) the coronal plane in the simulation of forehead heading; Locations of peak maximum principal strain are shown by red stars, and the time sequence is numbered.

2.



Histological findings of the tested implant after healing. (1) 0 days: The implant is partly surrounded with original cortical bone (CB). No peri-implant new bone (NB) formation was observed in a bone marrow cavity. (2) 14 days: The implant is surrounded by cortical bone and newly formed bone in the bone marrow cavity. (3) 28 days: The implant is surrounded by dense cortical bone (CB) and newly formed bone in the bone marrow cavity. Moreover, woven bone (WB) combined with lamellar bone (LB) was observed in direct contact with the implant surface without the presence of fibrous tissue. (4) 56 days: The implant is surrounded by dense cortical bone (CB) and dense lamellar bone in the bone marrow cavity. Scale bar: 500 μm.

Major Publications

1. Chen HH, Lai WY, Chee TJ, Chan YH, Feng SW. Monitoring the Changes of Material Properties at Bone-Implant Interface during the Healing Process In Vivo: A Viscoelastic Investigation. BioMed research international 2017, 2017.
2. Chen HH, Chung CH, Lee CC, Yang CS, Wen YS, Lee CL, Chiang KT. ANALYSIS OF INTERVERTEBRAL ANGULATIONS AND MUSCULOSKELETAL SYMPTOMS OF THE SPINE IN THE MILITARY AIRCREWS OF TAIWAN. Biomedical Engineering: Applications, Basis and Communications 2017, 29 (02), 1750010.
3. Liu X, Chen HH, Lin YC, Nabilla SC, Liu WC, Wang WC, Shih SJ, Li Y, Lin CP, Zhao G. Composite Polyelectrolyte Multilayer and Mesoporous Bioactive Glass Nanoparticle Coating on 316L Stainless Steel for Controlled Antibiotic Release and Biocompatibility. Journal of Biomedical Nanotechnology 2018, 14 (4), 725-735.
4. Chen PY, Chou L, Hu CJ, Chen HH. In Finite element simulations of brain responses to soccer-heading impacts, 1st Global Conference on Biomedical Engineering & 9th Asian-Pacific Conference

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CHIH-WEI PENG RESEARCH TEAM :
NEURAL ENGINEERING ASSISTIVE TECHNOLOGY (NEAT)

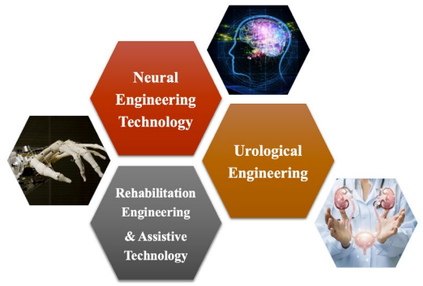
Chih-Wei Peng, Ph.D.,
Professor

Major Research Aims

My research employs neuroscience and engineering approaches to develop new therapeutic technologies to restore the motor or sensory functions in patients with neurodegenerative disease. We have successfully achieved several neuro-modulation technologies and applied these treatment approaches to restore physical functions in animal models and clinic patients with various neurological impairments. My current projects include:

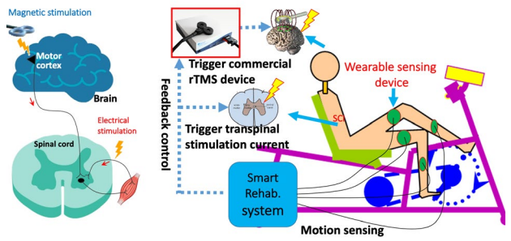
- developing novel brain stimulation system for neural rehabilitation.
- developing advanced neural engineering approaches to treat bladder functions.
- developing intelligent drop foot stimulator with real-time adaptive feedback control to adaptively generate stimulation intensity to enhance the walking ability in Parkinson's disease patient.
- developing paired associative nerve stimulation to restore motor function in spinal cord injured (SCI) patients.

Major fields



Representative Figures

1. Rehabilitation Effects on Lower Extremity Functions via Paired Associative Nerve Stimulation in Subjects with SCI.



2. Our Prototype Novel Transcranial Direct Current Stimulator.

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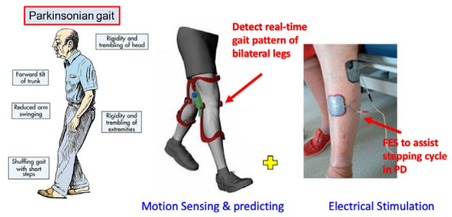
3. Prototype Intelligent Drop Foot Stimulator with Real-Time Feedback for Parkinsonian Gait.



1. **Neural engineering for restoring motor function via paired associative nerve stimulation in patient with SCI**
We are developing an intelligent neural rehabilitation system with evaluation and paired associative nerve stimulation for patients with SCI. The system is expected to improve the efficiency of SCI subjects' rehabilitation in the future and has the potential of commercialization.

2. **Novel transcranial direct current stimulator**
We are developing a novel transcranial direct current stimulator (t-DCS) system for rehabilitation therapy and other applications. Our developed system has been passed the safety certification and now used in animal and clinical studies to verify its therapeutic effects and the underlying mechanisms.

3. **Intelligent drop foot stimulator with real-time feedback control**
We are developing and testing an intelligent drop foot stimulator with real-time adaptive feedback control to enhance the walking ability in Parkinson's disease patients with freezing gait.

Major Publications

1. Y.T. Li, S.C. Chen, L.Y. Yang, T.H. Hsieh, C.W. Peng* (2019, May). Designing and implementing a novel transcranial electrostimulation system for neuroplastic applications: a preliminary study, IEEE Trans Neural Syst Rehabil Eng, 27(5):805-813. (IF=3.478, SCI, REHABILITATION, 5/65=7.7%)

2. S.D. Yeh, B.S. Lin, S.C. Chen, C.H. Chen, KJ. Gustafson, DJ. Bourbeau, CP. Rajneesh, C.W. Peng* (2019, Jun). Effects of Genital Nerve Stimulation Amplitude on Bladder Capacity in Spinal Cord Injured Subjects, Evid Based Complement Alternat Med, 2019:1248342. (IF=1.984, SCI, INTEGRATIVE & COMPLEMENTARY MEDICINE, 10/27=37.0%)

3. S.C. Chen, P.Y. Chu, T.H. Hsieh, Y.T. Li, C.W. Peng* (2017, Dec). Feasibility of Deep Brain Stimulation for Controlling the Lower Urinary Tract Functions: An Animal Study, Clinical Neurophysiology, 128(12):2438-49 (IF= 3.675, CLINICAL NEUROLOGY, SCI, 51/199=25.6%).

4. T.H. Hsieh, Y.T. Lin, S.C. Chen, C.W. Peng* (2016, April). Chronic Pudendal Neuromodulation by Using an Implantable Microstimulator Improves Voiding Function in Diabetic Rats, Journal of Neural Engineering, 13(4):046001. (IF=3.493, SCI, ENGINEERING, BIOMEDICAL, 14/76=13.2%)

5. S.C. Chen, T.H. Hsieh, W.J. Fan, C.H. Lai, W.F. Wei, C.W. Peng* (2015, May). Design and Evaluation of Potentiometric Principles for Bladder Volume Monitoring: A Preliminary Study, Sensors, 15(6), 12802-12815 (IF=2.245, SCI, 10/56=17.8%, INSTRUMENTS & INSTRUMENTATION).

JIAN-CHIUN LIOU : NANO BIOENGINEERING AND BIO-ASIC CHIP

Jian-Chiun Liou Ph.D.
Associate Professor

Major Research Aims

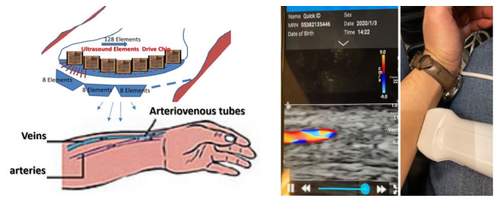
Nano medical chip and wisdom medical electromechanical system research team focus on DNA, cDNA, RNA and other cloth placed on a glass slide. It is an application-specific integrated circuit(ASIC) designed to spray liquid medical wisdom DNA gene sequencing system technology transfer fabric onto the glass slide. Design of Integrated High Voltage Pulse Generator for Medical Ultrasound Transmitters, it is reached by a CMOS device converts high voltage drive array technology integration and low-voltage CMOS logic technology, this technology is fully in control logic signal processing Level function. It is to precisely reach addressed spray a liquid jet chip circuit technology. The research project of wisdom medical electromechanical system proposes the integration of real-time heart rate monitoring platform. Multi-Channel Physiological Monitoring Integrated Artificial Intelligence Prosthetic Arm Assistive Learning System.

Major Achievements

1. Ultrasonic detection of blood flow rate in clinical patients. Ultrasonic mode low noise interference biological treatment and imaging common system and method.
2. Next-generation Intelligence an application-specific integrated circuit(ASIC) design for medical DNA sequence genes addressing system
3. Medical electronic ultrasonic photoelectric imaging system chip technology.
4. The research focuses are medical minimally invasive surgery technology for optical electromechanical systems.
5. This study is an ultrasonic probe chip imaging technology.

Representative Figures

1.



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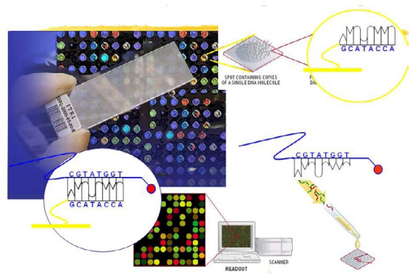

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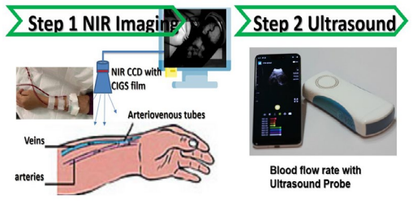

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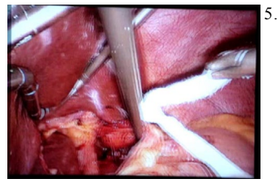

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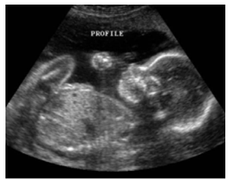

1. The study is the subject of DNA, cDNA, RNA and other cloth placed on a glass slide. It is an application-specific integrated circuit(ASIC) designed to spray liquid medical wisdom DNA gene sequencing system technology transfer fabric onto the glass slide.
2. It combined with the high frequency of high-density microfluidic structure design.
3. This study is a stroke patient receiving electrical stimulation therapy.
4. The research focuses are medical minimally invasive surgery technology for optical electromechanical systems.
5. This study is an ultrasonic probe chip imaging technology.

Major Publications

1. Jian-Chiun Liou, Cihun-Siyong Alex Gong, and Lung-Chien Chen,"Multi-Channel Physiological Monitoring Integrated Artificial Intelligence Prosthetic Arm Assistive Learning System",Journal of Nanoelectronics and Optoelectronics, Vol. 14, pp. 1–11 (2019).

2. Deng-Fong Lu, Chin Hsia, Jian-Chiun Liou, and Yen-Chung Huang,"Design of Integrated High Voltage Pulse Generator for Medical Ultrasound Transmitters", IEICE Transactions on Communications, Vol.E102-B, No.6, pp.1121-1127(2019).

3. Jian-Chiun Liou, "Circuitry of multiplexer-on-chip system within the micro-LED array manufacturing CMOS substrate", 2018nal: Optical and Quantum Electronics, DOI: 10.1007/s11082-018-1625-7(2018).

4. Jian-Chiun Liou, Cheng-Fu Yang,"Investigation of DNA sequencing droplet trajectory observation and analysis", Microelectronics Reliability, 91(2018) 243-250 (2018).

5. Jian-Chiun Liou, Yi-Tsung Chang,"Investigated of the Reproducibility of Upper-Limb Motor Function in Stroke Patients", Journal of Nanoelectronics and Optoelectronics, Volume 12, Number 8, August 2017, pp. 862-867(2017)SCI.

6. Jian-Chiun Liou, Te-Jen Su, Wen-Chieh Lin, and Wei-Jie Wen,"A novel printhead multiplexer data registration chip system with injection cavity design", Microsystem Technologies, DOI 10.1007/s00542-016-3147-1, pp.1-8.(2017)SCI.

7. Jian-Chiun Liou ,"Investigations of adhesion between waveguide and InP-laser with finger structure bonding" Computational Materials Science, Volume 122, Pages 30–37(2016)SCI.

8. Jian-Chiun Liou, Cheng-Fu Yang, and Cihun-Siyong Gong,"Design and Fabrication of Identification Inkjet Print Head Chip Fuse Sensors", Sensors and Materials, Volume 28, Number 5, pp. 493–501 (2016) SCI.

9. Jian-Chiun Liou, Chia-Ching Wu, Design and Fabrication of Microfluidic inkjet Chip with High Voltage ESD protection system for DNA droplets arrangement and detection, Microsystem Technologies-Springer Publishing Corporation, 12/2015;DOI:10.1007/s00542-015-2729-7,pp.1-15(2015) SCI.

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TMU BIOMEDICAL ENGINEERING RESEARCH TEAM

HUA-SHAN LIU :
MAGNETIC RESONANCE IMAGIING TECHNIQUES

Hua-Shan Liu, Ph.D.,
Assistant Professor

Major Research Aims

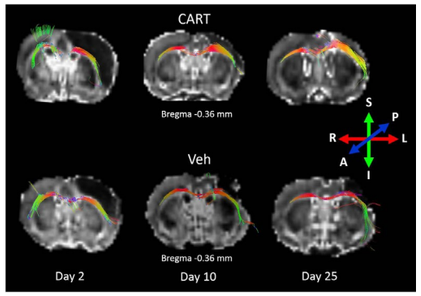
My research interests encompass the development of multimodal in vivo magnetic resonance (MR) imaging techniques in the fields of clinical and translational research, mainly focusing on the central nervous system, its related physiology and functions, and pathophysiology by using advanced MR imaging and spectroscopic techniques. Based on my extensive research experience and interests, I continue the accomplishments on MR perfusion-weighted imaging, quantitative susceptibility mapping and spectroscopy in application of the field for clinical and translational research. I hope to apply those techniques to study brain diseases and functioning in neuroscience and to develop more expertise related to studies of mental and neurobiological disorders, or psychological/psychiatric investigations.

Major Achievements

1. Use MR diffusion-tensor imaging (DTI) and susceptibility-weighted imaging (SWI) to detect the changes of white matter plasticity and angiogenesis in animal model of stroke.
2. Use MR SWI to demonstrate the iron depletion of dentate nuclei in ataxia-telangiectasia.
3. Use ASL-MRI to investigate the pathophysiological effects of chronic kidney disease (CKD) on brain function in children with CKD by correlating cerebral blood flow (CBF) with clinical and behavioral indices.
4. Assess the therapeutic efficacy of superparamagnetic erlotinib nanoparticles in lung cancer by using quantitative magnetic resonance imaging.
5. Use the first-pass pharmacokinetic model of permeability imaging of the MR perfusion-weighted imaging to effectively tumor grading in patients with gliomas.

Representative Figures

1.



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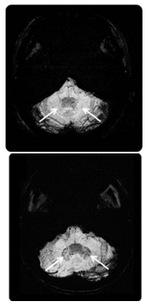

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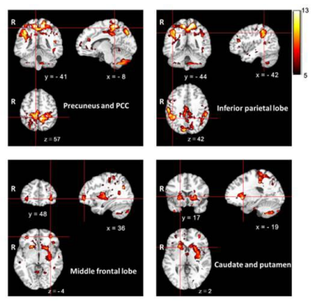

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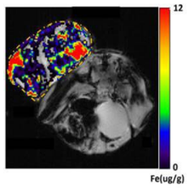

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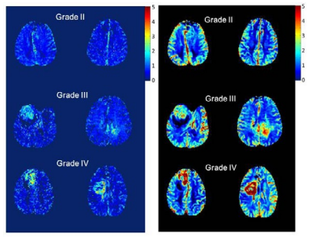

(1.) Post-stroke treatment with CART increased fiber growth in the ipsilateral cortex as revealed in diffusion-tensor imaging. (2.) Susceptibility-weighted images reveal an absence of hypointensity of the iron signal in the dentate nuclei of the patient with ataxia-telangiectasia (left). (3.) Overlapped clusters from all individual CKD subjects with positive extrema in CBF in the subject-specific voxel-wise analysis. (4.) Voxelwise estimates of the intratumoral iron concentration derived from changes in the $\Delta R2^*$ signal, which correlates to the amount of intratumoral erlotinib content. (5.) Representative histograms of K^{trans} and vp from patients with high- and low-grade gliomas.

Major Publications

1. Liu HS, Shen H, Luo Y, Hoffer BJ, Wang Y, Yang Y. Post-treatment with Cocaine- and Amphetamine-regulated Transcript Enhances Infarct Resolution, Reinnervation and Angiogenesis in Stroke Rats - A Magnetic Resonance Imaging Study. NMR Biomed. 2016; 29: 361–370.
2. Liu HS, Hartung EA, Jawad AF, Ware JB, Laney N, Port AM, Gur RC, Hooper SR, Radcliffe J, Furth SL, Detre JA. Regional Cerebral Blood Flow in Children and Young Adults with Chronic Kidney Disease. Radiology. 2018; In Press.
3. Liu HS, et al. Regional Cerebral Blood Flow in Children and Young Adults with Chronic Kidney Disease. Radiology. 2018; In Press.
4. Liu HS, Jawad AF, Laney N, Hartung EA, Furth SL, Detre JA. Effect of Blood T1 Estimation Strategy on Arterial Spin Labeled Cerebral Blood Flow Quantification in Children and Young Adults with Kidney Disease. J Neuroradiol. 2018. S0150-9861(17)30402-9.
5. Liu HS, Chiang SW, Chung HW, Tsai PH, Hsu FT, Cho NY, Wang CY, Chou MC, Chen CY. Histogram Analysis of T2-Based Pharmacokinetic Imaging in Cerebral Glioma Grading. Comput Methods Programs Biomed. 2018. 155:19-27.
6. Hsu FT, Liu HS, Ali AAA, Tsai PH, Kao YC, Lu CF, Huang HS, Chen CY. Assessing the Selective Therapeutic Efficacy of Superparamagnetic Erlotinib Nanoparticles in Lung Cancer by Using Quantitative Magnetic Resonance Imaging and a Nuclear Factor Kappa-B Reporter Gene System. Nanomedicine. 2018. S1549-9634(18)30021-2.

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YU-JUI (RAY) FAN :
TOTAL ANALYSIS SYSTEM ON TISSUE AND CELL (FAN TASTiC)

Yu-Jui (Ray) Fan, Ph.D.,
Assistant Professor

Major Research Aims

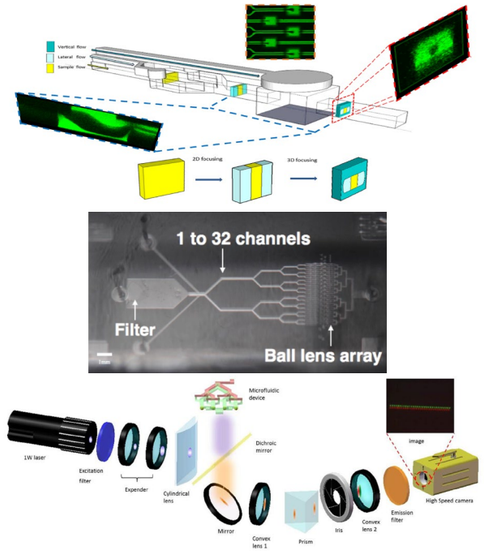
We are exploiting multi-couple physics that is able to achieve micro-environmental control or showed the potential for automation associated with miniaturized systems for biomedical applications including basic biology, medical diagnostics, and cellular engineering. Current studies are focusing on (1) vessel mimicking microfluidic system to investigate cellular responses after cyclic stretch force coupling with programmable sheath force, (2) lattice light sheet illuminated cell and tissue analyzer, (3) portable biosensors.

Major Achievements

1. High throughput and parallel micro-flow cytometer.
2. Vessel mimic microfluidic platform.
3. Smartphone-based biosensors integrated with Nanofluidic preconcentrator.

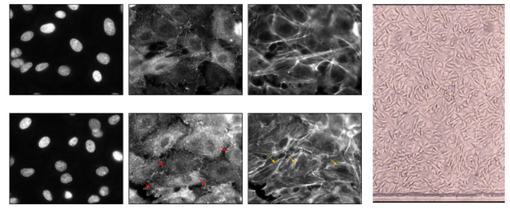
Representative Figures

1.



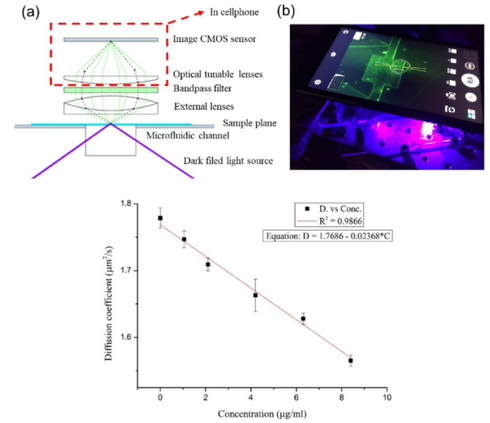
High throughput flow cytometer integrating parallel 3D microfluidic device with microball lens array. The optical system with epi-fluorescence detection and using 4F optical system to transport fluorescent signals to high speed camera. The prism is used to separate different color of fluorescent signals. The highest throughput of 1,000,000 cell/s was achieved.

2.



Vessel mimic flicrofluidic device for cell mechanics study.

3.



Smartphone based biosensors.

Major Publications

1. Chung PS, Fan YJ, Sheen HJ, Tian WC. Real-time dual-loop electric current measurement for label-free nanofluidic preconcentration chip. Lab on a Chip 2015;15:319-330.
2. Fan Y, Wu Y, Chen Y, Kung Y C, Wu T, Huang K, Sheen HJ, Chiou PY. Three dimensional microfluidics with embedded microball lenses for parallel and high throughput multicolor fluorescence detection. Biomicrofluidics 2013;7:44121.
3. Fan YJ, Deng CZ, Chung PS, Tian WC, Sheen H J.A high sensitivity bead-based immunoassay with nanofluidic preconcentration for biomarker detection. Sensors and Actuators B: Chemical 2018 ;272:502-509.
4. Fan YJ, Sheen HJ, Liu YH, Tsai JF, Wu TH, Wu KC, Lin S. Detection of C-reactive protein in evanescent wave field using microparticle-tracking velocimetry.Langmuir.2010;26: 13751-13754.
5. Chung PS, Fan YJ, Sheen HJ, Tian WC. Real-time dual-loop electric current measurement for label-free nanofluidic preconcentration chip. Lab on a Chip 2015, 15 (1), 319-330.

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THIERRY BURNOUF : PLATELET BIOMATERIALS

Thierry Burnouf, Ph.D.,
Distinguished Professor

Major Research Aims

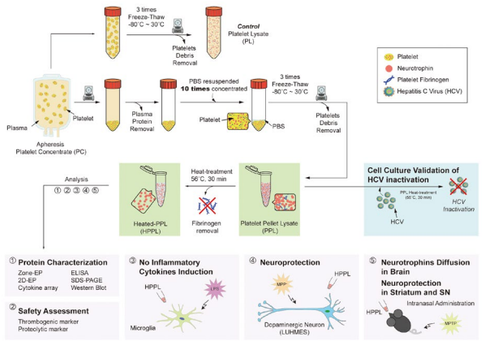
Human blood is a source of essential cellular and protein therapeutics to treat diseases resulting from accidents, aging, and congenital or acquired deficiencies. Our research aims at improving the quality of blood products, and expanding the range of blood-based therapies serving human health. With translation medicine applications in mind, our research focuses on exploring (a) applications of tailor-made platelet lysates and extracellular vesicles rich in growth factors in regenerative medicine (neurological disorders and ocular diseases) and cell therapy (mesenchymal stromal cell expansion), (b) use of blood cells and cell-derived extracellular vesicles as drug delivery system and therapies, and (c) novel bioprocessing technologies for the chromatographic purification and virus inactivation of blood proteins, in particular immunoglobulins. Our research has a strong international focus with close collaborations with foreign universities and research centers (Universities of Lille, Bourgogne Franche-Comté, France; Uppsala University, Sweden; University of Saskatchewan, Canada) as well as international industry.

Major Achievements

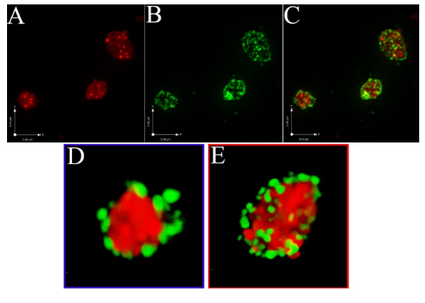
1. Tailor-made platelet lysate rich in neurotrophins to treat neurodegenerative diseases of the CNS, traumatic brain injury and corneal endothelium damages.
2. Procedures to prepare and use platelets as drug delivery system.
3. Characterization of platelet-derived extracellular vesicles as drug delivery vehicles and regenerative medicine adjunct.
4. Clinical grade, virally-inactivated human platelet lysates for human cell (e.g. mesenchymal stromal cells) propagation ex vivo.
5. Procedure to remove prions and non-enveloped viruses from platelet lysates for cell expansion.
6. Virus inactivation process of convalescent plasma and immunoglobulins against infectious diseases such as COVID-19.

Representative Figures

1.



2.



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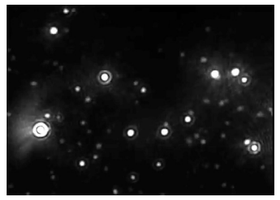
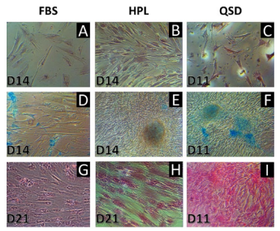


4.



1. Tailor-made human platelet lysate concentrated in neurotrophins for treatment of neurodegenerative disorders.
2. Entrapment of doxorubicin within a platelet microcarrier for targeted cancer treatment.
3. Observation of platelet-derived extracellular vesicles by Nanoparticle Tracking Analysis.
4. Differentiation capacity of Wharton Jelly MSC expanded in human platelet lysates treated for prion and virus removal.

Major Publications

1. Schallmoser K, Henschler R, Gabriel C, Koh MBC, Burnouf T*. Production and quality Requirements of human platelet lysate: A Position Statement from the working party on cellular therapies of the International Society of Blood Transfusion. Trends in Biotechnology, 2020;38:13-23.
2. Wu YW, Huang CC, Changou CA, Lu LS, Goubran H,Burnouf T*. Clinical-grade cryopreserved doxorubicin-loaded platelets: role of cancer cells and platelet extracellular vesicles activation loop. Journal Biomedical Science, 2020;27:45
3. Nebie O, Devos D, Vingtdeux V, Barro L, Devedjian JC, Jonneaux A, Chou ML, Bordet R, Buée L, Knutson F, Blum D*, Burnouf T*. The neuroprotective activity of heat-treated human platelet lysate biomaterials manufactured from outdated pathogen-reduced (amotosalen/UVA) platelet concentrates. Journal of Biomedical Science, 2019; 26, 89.
4. Agrahari V, Agrahari V, Burnouf PA, Chew CH, Burnouf T*. Extracellular Microvesicles as New Industrial Therapeutic Frontiers. Trends in Biotechnology 2019;37:707-729.
5. Burnouf T*. Blood products: unmet needs for essential blood products. The Lancet Haematology, 2019; 6:e598-E599.
6. Chou ML, Wu JW, Gouel F, Jonneaux A, Timmermann K, Renn TY, Laloux C, Chang HM, Lin LT, Devos D, Burnouf T*. Tailor-made purified human platelet lysate concentrated in neurotrophins for treatment of Parkinson's disease. Biomaterials 2017, 142, 77-89.
7. Burnouf T*, Dye JM, Abayomi, A. Convalescent plasma and the dose of Ebola virus. New England Journal of Medicine, 2017; 376: 1296-1297.
8. Burnouf T, Strunk D*, Koh M, et al. Human platelet lysate: replacing fetal bovine serum as a gold standard for human cell propagation? Biomaterials 2016; 76:371-87.

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DER-ZEN LIU : LIPOSOMAL VACCINE

Der-Zen Liu, Ph.D.,
Professor

Major Research Aims

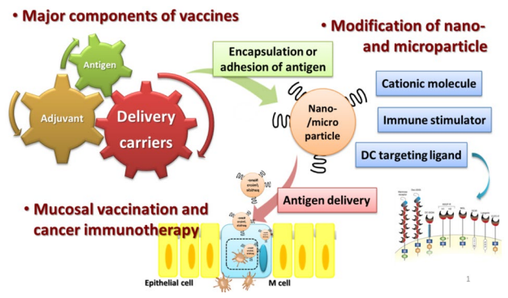
The mucosal surfaces, such as the gastrointestinal and respiratory tracts, represent the main entry site for most infectious agents. Thus, mucosal immunity provides the first line of defense against harmful microorganisms. Mucosal surfaces contain specialized dendritic cells (DCs), which play a critical role in recognizing environmental pathogens, as well as in initiating and regulating adaptive immune responses. Therefore, it is important to develop effective mucosal DC-targeted vaccines to induce protective immunity against cancer or viral infection. Thus, we develop novel targeted-liposomal delivery platform to delivery of antigens across mucosal membranes and target to dendritic cells. Thus, targeted-liposomes are able to achieve more effective protective effects that will be useful for the prevention of infectious diseases and treatment of mucosal tumors.

Major Achievements

1. Galactose-DLPE targeting ligand (formed by the covalent conjugation of galactose to DLPE) incorporated into liposomal bilayer to form a targeted galactosylated liposome carrier.
2. Galactosylated liposomes effectively facilitated antigen uptake by DCs in vitro and in vivo.
3. Intranasally administrated galactosylated liposomal vaccine led to an efficient anti-OVA immune response against EG7 tumor challenge.

Representative Figures

1.



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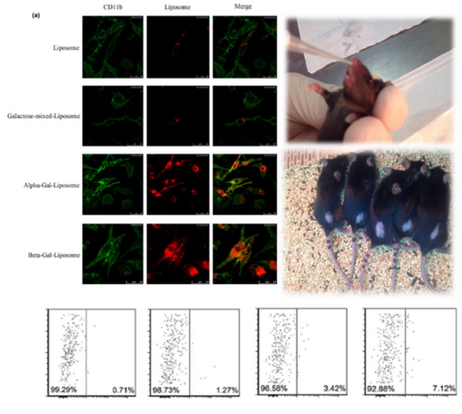

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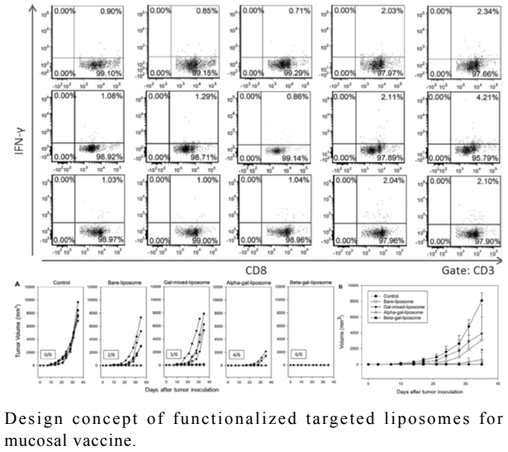

1. Design concept of functionalized targeted liposomes for mucosal vaccine.
2. Galactosylated liposomes effectively facilitated antigen uptake by DCs in vitro and in vivo via the intranasal route.
3. The number of IFN-c producing CD8+ T cells was increased in mice immunized with alpha-gal-liposomes and significantly increased in galactosylated liposomes. Five sixths and six sixths mice receiving alpha-gal-liposomes and beta-gal-liposomes, respectively, completely rejected the EG7 tumor challenge.

Major Publications

1. Jiang PL, Lin HJ, Wang HW, Tsai WY, Lin SF, Chien MY, Liang PH, Huang YY, Liu DZ*. Galactosylated liposome as a dendritic cell-targeted mucosal vaccine for inducing protective anti-tumor immunity. Acta Biomaterialia. 2015; 11:356-67.
2. Wang HW, Jiang PL, Lin SF, Lin HJ, Ou KL, Deng WP, Lee LW, Huang YY, Liang PH, Liu DZ*. Application of galactose-modified liposomes as a potent antigen presenting cell targeted carrier for intranasal immunization. Acta Biomaterialia. 2013;9(3):5681-8
3. Cheng HC, Chang CY, Hsieh FI, Yeh JJ, Chien MY, Pan RN, Deng MC, Liu DZ*. Effects of tremella-alginate-liposome encapsulation on oral delivery of inactivated H5N3 vaccine. J Microencapsul. 2011;28(1):55-61.
4. Chiou CJ, Tseng LP, Deng MC, Jiang PR, Tasi SL, Chung TW, Huang YY, Liu DZ*. Mucoadhesive liposomes for intranasal immunization with an avian influenza virus vaccine in chickens. Biomaterials. 2009;30(29):5862-8.

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CHIEN-CHUNG CHEN : MICROTUBE ARRAY MEMBRANE (MTAM)

Chien-Chung, Chen, Ph.D.,
Professor

Major Research Aims

Core to the research interest of the group revolves around the development of the novel electrospun microtube array membrane (MTAM). Depending on the intended application, materials and key microstructures can be modified to fulfill the requirements and produces unique membrane properties. Applications of MTAMs have been demonstrated in areas such as anti-cancer drug screening (personalized medicine & drug development) where a novel platform with highly translatable outcome, extremely rapid screening process and significant reduction in screening cost have been demonstrated. Another key area of focus is the tissue engineering area where the use of the MTAMs as a novel co-culture substrate has been demonstrated. In regards to tissue engineering, a key area revolves around the development of a vitro model for drug release study that can potentially replace animals. Additionally, the group also work on project related to the hemodialysis and endotoxin removal where the MTAMs have demonstrated excellent and improved filtration efficiency while reducing the overall time and cost associated.

Major Achievements

1. Holds/part of over 15 international patents.
2. Published over 80 abstracts and peer reviewed journals.
3. Spin-off company based on MTAM technology.

Patents:

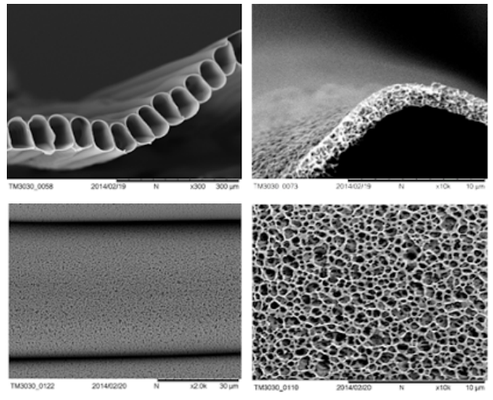
(1) MTAM: US & Taiwan IPs
- USP 8540504, 2013
- USP 9139935, 2014
- USP 9091007B2, 2015
- TWN I315358, 2009
- TWN I445856, 2014
- TWN I508836, 2015

(2) MTAM-Aplication based-neuroregeneration
- TWN I374037

(3) MTAM-Application-Fermentation/Immobilization
- USP 9758778
- TWN I592488, 2017

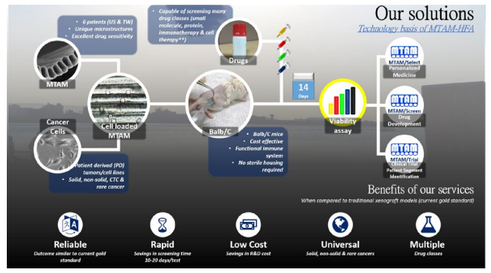
Representative Figures

1.



SEM images of electrospun MTAMS with highly unique microstructures; ultra-thin, homogenously porous and high-aligned fibers arranged in an arrayed formation.

2.



Electrospun Microtube Array Membrane (MTAM) and its applications in the anti-cancer drug screening for personalized medicine and drug development.

3.

Snapshot of awards and trade shows participated in past years.

Major Publications

1. Tseng CH, Chew CH, Huang WT, Wang YK, Chen K, Chou S, Chen CC. An Effective Cell Coculture Platform Based on the Electrospun Microtube Array Membrane (MTAM) for Nerve Regeneration. Cells Tissues Organs 2017, 204(3-4):179-190.
2. Morelli Sabrina,Piscioneri Antonell,Salerno Simona,Chen CC,Chew CH,Giorno Lidietta, Drioli Enrico, De Bartolo Loredana. Microtube array membrane bioreactor promotes neuronal differentiation and orientation. Biofabrication 2017, 9(2):025018.
3. Chew CH,Wu CC,Chen CC. A novel electrospun Microtube Array Membrane (MTAM) based low cost conceptual tubular Microbial Fuel Cell (MFC). European Polymer Journal 2016, (83):138-147.
4. Chen CC,Wu CH,Wu JJ,Chiu CC,Wong CH,Tsai ML Lin HT. Accelerated bioethanol fermentation by using a novel yeast immobilization technique: Microtube array membrane. Process Biochemistry 2015, 50(10): 1509–1515.
5. Yang SH,Lin HY,Chang VH,Chen CC,Liu YR,Wang J Zhang K Jiang X, Yen Y. Lovastatin overcomes gefitinib resistance through TNF-α signaling in human cholangiocarcinomas with different LKB1 statuses in vitro and in vivo. Oncotarget 2015, 6(27):23857-73.

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CHING-LI TSENG : BIOMATERIAL DESIGN FOR DRUG DELIVERY, TISSUE REGENERATION- OPHTHALMOLOGY

Ching-Li Tseng, Ph.D.,
Associate Professor

Major Research Aims

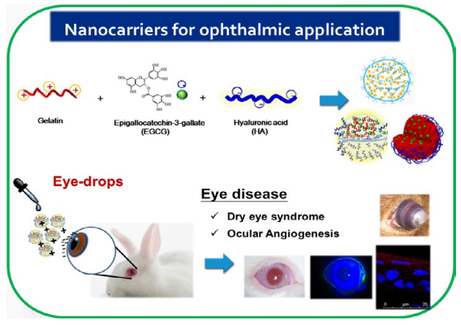
Biomaterials have broad application in medical device, tissue regeneration, and drug delivery. The same material can have totally different influence on cell function depending whether it is fabricated in micro- or nano- scale. In this lab, biological polymers such as gelatin, collagen, chitosan and hyaluronic acid are used to be drug carriers, cell scaffold etc. for disease treatment. We focused on novel formulation development for non-invasive drug delivery, especially on ophthalmology and lung cancer. New formulation with better patient compliance and targeting efficiency can be the way to improve therapeutic effect in clinics. These years, we designed and developed gelatin nanoparticles to treat dry eye syndrome, cornea neovascularization in an eye drop formulation. It is proven that nanoparticles can increase the bioavailability of drug on ocular surface, then effectively treat these diseases via one time dosing daily. The therapeutic effect of these nanoformulation in retina disease is tested now. Inhalation delivery of nanomedicine for treating lung cancer in situ is also proven due to highly increase chemodrug concentration in lung with targetable capacity for cancer tissue only.

Major Achievements

1. Targetable drug carrier design for ocular diseases treatment.
2. Controlling stem cell differentiation by nanotechnology for retina regeneration
3. Degradable biopolymer synthesis for tissue regeneration.
4. Inhalation delivery of nanomedicine for lung cancer diagnosis and treating.
5. Preclinical test for evaluation of therapeutic effect in dry eye syndrome, cornea angiogenesis, and lung cancer.

Representative Figures

1.



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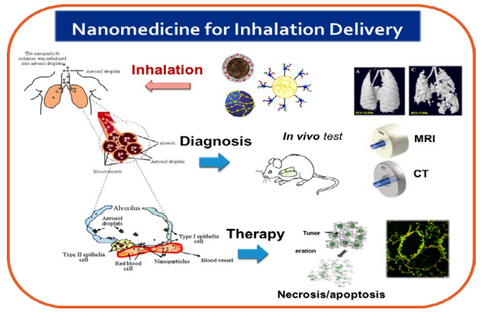

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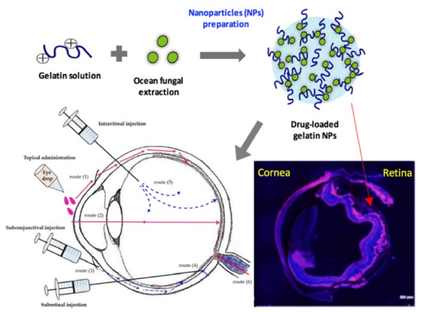

1. Self-assembling nanoparticles with antiinflammation/ antiangiogenesis agent (tea polyphenol/gp91 peptide) encapsulation as eye drops can effectively treating dry eye syndrome and cornea neovascularization.
2. Polymeric nanoparticle with epithelium growth factor (EGF) modification could targeting to EGF receptor (EGFR) overexpressed lung cancer cells by inhalation delivery. Meanwhile, MRI contrast agent (Iron oxide) or CT contrast agent (gold/ iodine based NPs) can also be packaged in it for theronostic cancer treatment.
3. Investigating the delivery efficacy of nanoformulation delivered in variant ways (eye drops, subconjunctiva/vitreous injection) to the posterior eye-retina.

Major Publications

1. Miyagawa T, Chen ZY, Chang CY, Chen KH, Wang YK, Liu GS, Tseng CL*. Topical application of hyaluronic acid-RGD peptide coated gelatin / epigallocatechin-3 gallate (EGCG) nanoparticles inhibits corneal neovascularization via inhibition of VEGF production. Pharmaceutics, 2020, 12, 404; doi: 10.3390/pharmaceutics12050404
2. Chuang YL, Fang HW, Ajitsari A, Chen KH, Su CY, Liu GS, Tsneg CL*. Development of Kaempferol-Loaded Gelatin Nanoparticles for the Treatment of Corneal Neo-vascularization in mice. Pharmaceutics, 2019, 11, 635, 1-16
3. Huang HY Huang, Wang MC, Chen ZY, Chiu WY, Chen KH, Lin IC, Tseng CL*. Gelatin–Epigallocatechin Gallate Nanoparticles with Hyaluronic Acid Decoration as Eye Drops Can Treat Rabbit Dry-Eye Syndrome Effectively via Inflammatory Relief. Int J Nanomed (2018):13 7251–7273.
4. Chang CY, Wang MC, Miyagawa T, Chen ZY, Tseng CL*. Preparation of RGD modified Biopolymeric nanoparticles containing epigalloccatechin-3- gallate for targeting vascular endothelial cells to inhibit corneal neovascularization. Int J Nanomed. (2017) 12: 279–294.

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ER-YUAN CHUANG : DRUG DELIVERY

Er-Yuan Chuang, Ph.D.,
Associate Professor

Major Research Aims

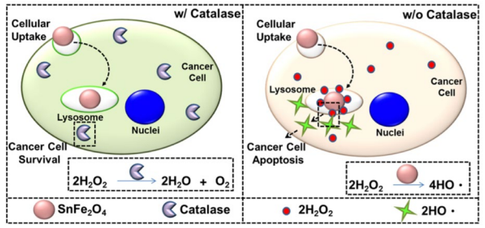
We are interested in drug delivery and biomaterials. Our team work is particularly focused on developing innovative nanobiomaterials, which are expected to enhance the efficacy of treatment against human diseases. We are studying formulated materials characteristics, physiochemical property, impact on cell viability, and biomolecular mechanisms. We try to invent cost-effective processes to fabricate useful next-generation therapeutic materials. Our guidelines of development include biocompatibility, bioefficacy, clinical value, and meaningful industrial needs. We have been developing partnerships with clinicians and industry scientists to optimize our biomaterials, prepare superior formulations and conduct pre-clinical animal studies. Carbon based nanomaterials are currently our main field of research.

Major Achievements

1. The carbon based nanomaterials are currently main researches.
2. Genipin-crosslinked adipose stem cell derived extracellular matrix-nano graphene oxide composite sponge for skin tissue engineering has been developed.
3. In addition to study of potential administration, the proposed nanocarrier systems have potential applications as a platform for different administrations of other therapeutic substance.

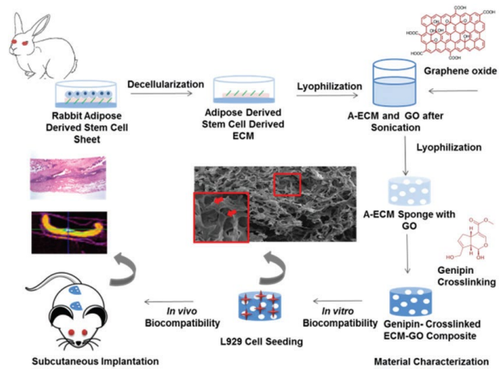
Representative Figures

1.



The development of nano-biomaterials are used for biomedical applications.

2.



The biomedical materials are developed for tissue engineering and regenerative medicine.

Major Publications

1. Nyambat, B., Chen, C. H., Wong, P. C., Chiang, C. W., Satapathy, M. K., & Chuang, E. Y. (2018). Genipin-crosslinked adipose stem cell derived extracellular matrix-nano graphene oxide composite sponge for skin tissue engineering. Journal of Materials Chemistry B, 6(6), 979-990.
2. Mi, F. L., Burnouf, T., Lu, S. Y., Lu, Y. J., Lu, K. Y., Ho, Y. C., et al. (2017). Self-Targeting, Immune Transparent Plasma Protein Coated Nanocomplex for Noninvasive Photothermal Anticancer Therapy. Advanced healthcare materials, 6(14), 1700181.
3. Lee, K. T., Lu, Y. J., Mi, F. L., Burnouf, T., Wei, Y. T., Chiu, S. C., et al. Catalase-modulated heterogeneous Fenton reaction for selective cancer cell eradication: SnFe2O4 nanocrystals as an effective reagent for treating lung cancer cells. ACS applied materials & interfaces, 9(2), 1273-1279.
4. Satapathy, M. K., Nyambat, B., Chiang, C. W., Chen, C. H., Wong, P. C., Ho, P. H., et al. A Gelatin Hydrogel-Containing Nano-Organic PEI–Ppy with a Photothermal Responsive Effect for Tissue Engineering Applications. Molecules, 23(6), 1256.
5. Chuang, Er-Yuan, Lin, Kun-Ju, Huang, Tring-Yo, et al. An Intestinal "Transformers"-Like Nanocarrier System for Enhancing the Oral Bioavailability of Poorly Water-Soluble Drug. ACS Nano 2018 (Accepted).

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YIN-JU CHEN : CANCER TRANSLATIONAL RESE ARCH L ABORATORY

Yin-Ju Chen, Ph.D.,
Assistant Professor

Major Research Aims

My research interest in gaining insights into the processes that underlie cancer initiation, progression and therapeutic resistance to discover potential biomarkers, therapeutic targets and drugs.

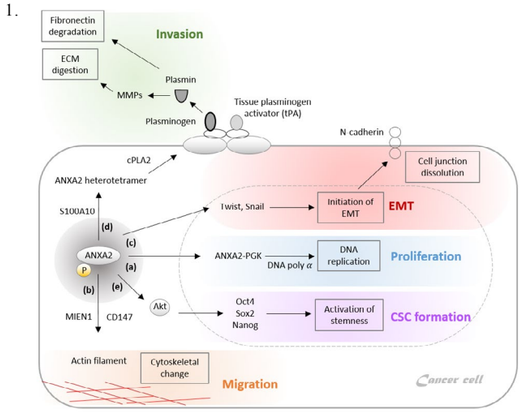
- Identify cancer associated or chemo-resistance genes. A broad array of technologies that include cellular, molecular biology techniques were utilized.
- Expansion and characterization of circulating tumor cells (CTCs) for searching of circulating tumor markers and development personalized cancer drug screening platform.
- Integration of genomic information and drug database to find potential therapeutic drugs to improve the efficacy of therapy.

Major Achievements

1. Characterization of cancer associated genes CHES1, DSG3, Annexin A2, Cyr61 contribute to cancer progression.
2. Liquid biopsy for cancer management- High-yield in vitro CTC expansion platform for precision medicine.
3. Genomic approach to Identify potential compound to reverse cancer malignant and cancer stemness.

Representative Figures

1.



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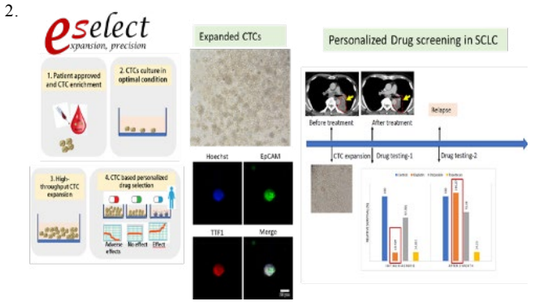

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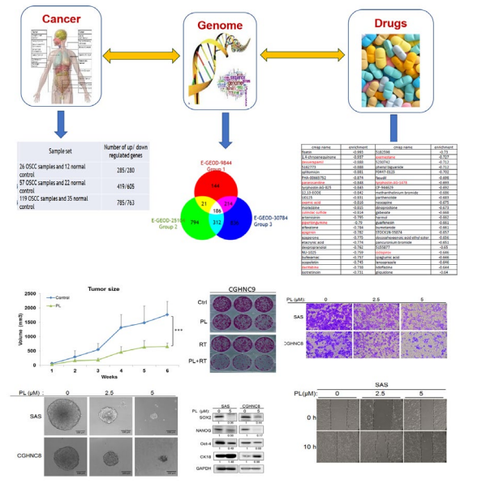

1. Annexin A2 in malignant tumors: the molecular mechanism of annexin A2 contributes tumor growth, migration, epithelial-mesenchymal transition, invasion, and cancer stem cell formation.
2. Personalized cancer medicine with in vitro expanded circulating tumor cells.
3. Systemic approach to identify potential therapeutic drugs through systemic bioinformatics approach.

Major Publications

1. You GR, Cheng AJ, Lee LY, Huang YC, Liu H, Chen YJ, Chang JT. Prognostic signature associated with radioresistance in head and neck cancer via transcriptomic and bioinformatic analyses. BMC Cancer. 2019 Jan 14;19(1):64
2. Chen CY, Lin YS, Chen CH, Chen YJ. Annexin A2-mediated cancer progression and therapeutic resistance in nasopharyngeal carcinoma. J Biomed Sci. 2018 Mar 29;25(1):30
3. Chen YJ, Kuo KK, Ting LL, Lu LS, Lu YC, Cheng AJ, Lin YT, Chen CH, Tsai JT, Chiou JF. Piperlongumine inhibits cancer stem cell properties and regulates multiple malignant phenotypes in oral cancer. Oncology Letters 2018 Feb;15(2): 1789-1798
4. Lu LS, Chen YJ, Lin YT, Lee JT, Chiou JF (2017, Aug). Ionizing radiation- induced cancer stemness gene expression is regulated by matrix nanotopography. Therapeutic Radiology and Oncology.

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LONG-SHENG LU : TRANSLATIONAL RADIATION BIOLOGY

Long-Sheng Lu, M.D, Ph.D.,
Assistant Professor

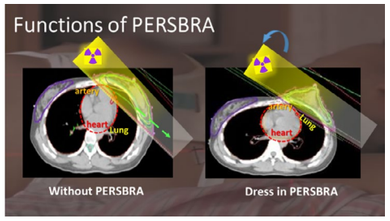
Major Research Aims

The Lu lab is interested in understanding how ionization radiation alters tumor-host interaction to achieve long-term control of cancers and minimize normal tissue side effects. We dedicate efforts to unmet clinical needs in radiation oncology, and solve these issues with an integrated BME approach. In the lab, we use live cell microscopy, image cytometry, molecular biology, explant culture, smart biomaterials, and murine models to explore the non-canonical effects of ionizing radiation. These bench findings are actively translated to new strategies for normal organ protection, personalized in vitro tests, targeted drug delivery, and anticancer immunity in the settings of metastatic breast and colorectal cancers. In the clinics, we are interested in radiation-assisted immunotherapy, personalized oncology, and cardiovascular protection for curative cancer treatment

Our Significant Contributions

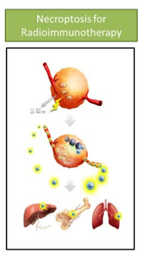
1. **Personalized breast holder (PERSBRA)**

   The unique value proposition of PERSBRA is that a customized unilateral breast holder is able to stably maintain a breast position that is compatible with cardiac sparing during whole breast irradiation. The breast position is derived from the torso contour when the patient is on a semi-prone position, in which breast stability is secured by gravity. Personalized manufacturing is made possible by introduction of polymer 3D printing technology. The concept has been tested in a cohort of 30 women with left breast cancer, and dosimetric analysis suggested that this simple workflow is as effective as DIBH to spare the heart by 30% dose reduction. Moreover, the turnaround efficiency with PERSBRA is at least 4 times higher comparing to DIBH. The implementation of PERSBRA requires no additional training on radiotherapy staffs, and the associated device is portable. Putting together, PERSBRA is a novel cardiac sparing solution for community radiation oncology units.



2. **Radiation assisted immunotherapy**

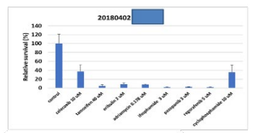
   Cancer immunotherapy not only controls the primary tumor but also work systemically to destroy distant metastatic lesions. Our lab is trying to develop novel in situ tumor vaccination strategy with precision radiation plus intratumoral drug delivery that collectively promote programmed necrosis of cancer cells and reprogramming of tumor microenvironment.



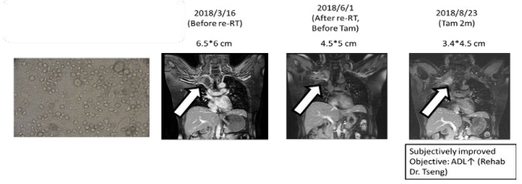
3. **Circulating sarcoma cells for personalized oncology**

   We developed a unique technology that can efficiently expand circulating sarcoma cells. These cells represent novel opportunities for personized oncology, especially when it is used for drug sensitivity testing. In a case of recurrent desmoid tumor, circulating sarcoma cells were expanded into cell clusters from the peripheral blood (bottom left), and drug screening found that the tumor responded sensitively to Tamoxifen (top left ; Histogram of drug response, right table: the percentage of drugs that inhibit cell proliferation relative to untreated cells detected). The patient was treated with Tamoxifen and dramatic clinical and image improvement were seen (lower row), which is consistent with cellular sensitivity results. In another case,

Patient name	Chart No.	Referring physician	Clinical Diagnosis
		呂隆昇	Aggressive Desmoid Tumor
Date of specimen collection	Date of specimen operation	Blood volume	Date of report
20180402	20180402	21 ml	20180608
Note:			



Drug	癌細胞存活率	
celecoxib 10 uM	37.20	
tamoxifen 40 uM	4.52	
eribulin 2 uM	8.57	
adriamycin 0.178 uM	7.75	
ifosphamide 3 uM	2.32	
pazopanib 3 uM	2.60	
regorafenib 5 uM	2.30	
cyclophosphamide 10 uM	35.54	



Major Publications

1. Chu HY*, Lu LS*, Cho W, Wu SY, Chang YC, Lin CP, Yang CY, Lin CH, Jiang JK, Tseng FG: Enumerating circulating tumor cells with selfassembled cell array (SACA) chip: a feasibility study in patients with colorectal cancer. Cancers (Basel). 2019 Jan 8;11(1). pii: E56. doi: 10.3390/cancers11010056.
2. Huang CF, Colley MMS, Lu LS, Chang CY, Peng PW, Yang TS: Performance characterization of continuous-wave laser-induced forward transfer of liquid bioink. Applied Physics Express, 2019 12(11)116504.
3. Lin CH, Lee HH, Kuei CH, Lin HY, Lu LS, Lee FP, Chang J, Wang JY, Hsu KC, Lin YF. Nicotinic Acetylcholine Receptor Subunit Alpha-5 Promotes Radioresistance via Recruiting E2F Activity in Oral Squamous Cell Carcinoma. J Clin Med. 2019 Sep 12;8(9). pii: E1454. PubMed Central PMCID: PMC6780171.
4. Lee HH, Lin CH, Lin HY, Kuei CH, Zheng JQ, Wang YH, Lu LS, Lee FP, Hu CJ, Wu D, Lin YF. Histone 2A Family Member J Drives Mesenchymal Transition and Temozolomide Resistance in Glioblastoma Multiforme. Cancers (Basel). 2019 Dec 30;12(1). pii: E98. doi: 10.3390/cancers12010098.
5. Wu YW, Huang CC, Changou CA, Lu LS, Goubran H, Burnouf TH: Clinical-grade cryopreserved doxorubicin-loaded platelets: role of cancer cells and platelets extracellular vesicles activation loop. J Biomed Sci 2020 (accepted)

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DAVID J. LUNDY : DRUG DELIVERY, NANOMEDICINE AND TISSUE ENGINEERING

David J. Lundy, Ph.D.,
Assistant Professor

Major Research Aims

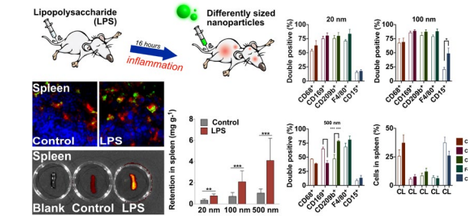
My research interests lie in the fields of tissue engineering, cell therapy and in vitro models. In particular, my lab is working on utilizing a combination of biomaterials and stem cells for cell therapy of ischaemic tissues, such as myocardial infarction. My PhD project was tissue engineering of a human epidermal skin equivalent for in vitro testing of cosmetic or pharmaceutical compounds and I have also worked on the development of a drug capture system for improved delivery of therapeutics to critical limb ischaemia, myocardial infarction and brain disorders, and my postdoctoral fellowship focused on increasing delivery of nanotherapeutics through the blood brain barrier for the treatment of glioma.

Major Achievements

1. Demonstration of anti-PEG antibody-based reloadable drug capture system in a porcine model of limb ischaemia.
2. Understanding mechanisms of size-dependent distribution of nanomedicines during systemic inflammation.
3. Determination of optimal nanoparticle retention at site of cardiac ischaemia-reperfusion injury.
4. Improved delivery of nanotherapeutics to brain parenchyma via transient weakening of blood-brain barrier.

Representative Figures

1.



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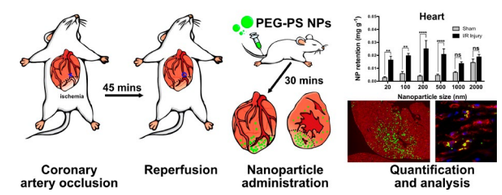

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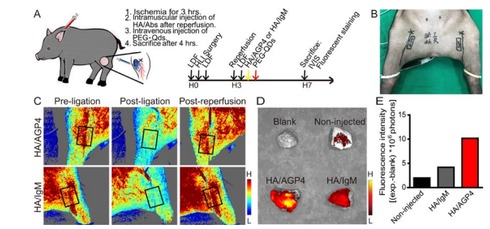

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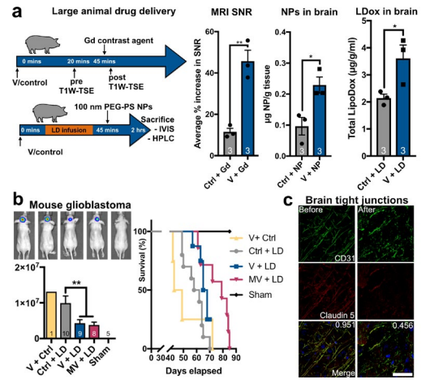

1. Demonstration of reloadable drug capture system in porcine model of limb ischaemia. Systemically injected PEG-modified quantum dots were retained at the injection site.
2. Systemically-injected nanoparticles are retained at the ischemia-reperfusion injured heart in a size-dependent manner.
3. During systemic inflammation, nanoparticles are increasingly retained by the spleen due to uptake by a specific lineage of splenic leucocytes.
4. Large animal demonstration of enhanced delivery of Gadolinium, nanoparticles (NPs), LipoDox (LDox) to the brain. Delayed tumour growth and improved survival in mouse glioblastoma model. BBB permeability enhanced by reducing tight junction integrity.

Major Publications

1. Lundy DJ et al, 2019. Inducing a transient increase in blood brain barrier permeability for improved therapy of glioblastoma multiforme. ACS Nano. 13, 97-113
2. Wu PJ, Cheng B, Roffler SR, Lundy DJ et al, 2016. Reloadable Multi-Drug Capturing Delivery System for Targeted Ischemic Disease Treatment. Sci Trans Med. 8
3. Lundy DJ et al, 2016. Distribution of Systemically Administered Nanoparticles Reveals a Size-Dependent Effect Immediately following Cardiac Ischaemia-Reperfusion Injury. Sci. Rep. 6, 25613
4. Chen KH & Lundy DJ et al, 2015. Nanoparticle distribution during systemic inflammation is size-dependent and organ-specific. Nanoscale 7, 15863–15872

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TMU BIOMEDICAL ENGINEERING RESEARCH TEAM

JEN-CHANG YANG RESEARCH TEAM : Dental Materials & Medical Devices

Major Research Aims

The Graduate Institute of Nanomedicine and Medical Engineering (GINME) aims to focus on translational researches on addressing unmet clinical needs through innovations and advances in nanotechnologies. Nanomaterials for medical devices as well as the nanotechnology based diagnostics are two major focused areas of GINME. The implementation of nanomaterials into medical device applications and long-term translational research toward clinical trials will be the main tasks. My personal interested fields are the dental materials and medical devices toward preventive and minimum invasive medical applications. Bio-inspired and digital design (MGI+AI) driven silk protein fibers in design, synthesis, fabrication for translational researches are under development for new applications.

Jen-Chang Yang, Ph.D.,
Professor

Major Achievements

1. **Fast-setting Root Canal Filling Materials**

   Root canal therapy is a common dental procedure to treat the inside of the tooth. Endodontic treatment is necessary when the pulp becomes inflamed or infected. Mineral trioxide aggregate (MTA) has been successfully used in multifaceted endodontic applications such as root end filling, apexification, pulpotomy, and vital pulp therapy because of its unique biocompatibility, antibacterial nature, sealability, and its capacity to promote hard tissue formation. However, MTA is difficult to use for practitioners because of its properties of granular consistency, slow setting time, and initial looseness. The SavDen® MTA developed at TMU using a proprietary dual-function additive resulting in a fast setting, cement based filling material.

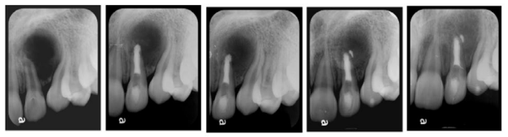

Figure 1.
The clinical efficacy of SavDen MTA for rood canal filling materials developed in TMU.

2. **Bio-inspired and digital design (MGI+AI) driven silk protein fibers in design, synthesis, fabrication for translational researches**

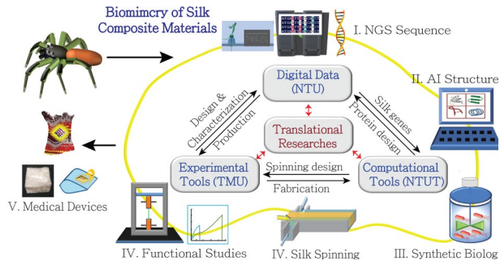

Figure 2.
The Framework for Spider Silk Integrated Project.

3. **Long Lasting (CLP) Based Desensitizing Agent**

   Dentinal hypersensitivity (DH) has been researched extensively due to its widespread prevalence and is a painful oral health problem that affects many individuals. To take advantages of remineralizing agents as a desensitizing agent, calcium lactate phosphate (CLP), a soluble calcium salt of calcium oxide, lactic acid, and phospheric acid, was developed in our laboratory. Figure 1 showed that using CLP pastes as desensitizing agents offers good prospects for instant and 14 days constant-increasing dentinal tubule occlusion. The newly developed CLP paste may be a good alternative treatment for dentin hypersensitivity relief.

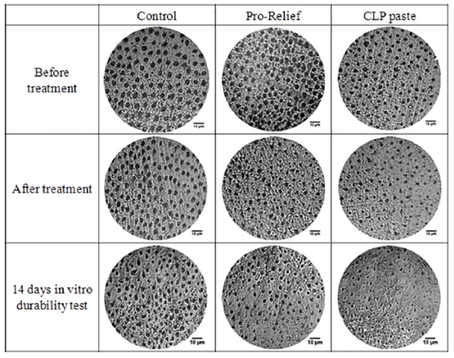

Figure 3.
The optical micrographs of occlusal dentin disk surface pre-treatment, immediately post-treatment, and 14 days post-treatment of various desensitizing pastes.

Major Publications

1. Hsuan-Chen Wu, Aditi Pandey, Liang-Yu Chang, Chieh-Yun Hsu, Thomas Chung-Kuang Yang, I-Min Tso, Hwo-Shuenn Sheu, Jen-Chang Yang. Hydrothermal Effect on Spider Silk Spidroin Properties of Nephila pilipes. Polymers-BASEL 2020, 12(5), 1013. (3.162/19.5%)
2. Ching-Shuan Huang, Sung-Chih Hsieh, Nai-Chia Teng, Wei-Fang Lee, Poonam Negi, Wendimi Fatimata Belem, Hsuan-Chen Wu, Jen-Chang Yang *, A Silk Fibroin Based Hydration Accelerator for Root Canal Filling Materials. Polymers-BASEL, 2020, 12 (4), 994. (3.162/19.5%).
3. Hsieh SC, Teng NC, Chu CC, Chu YT, Chen CH, Chang LY, Hsu CY, Huang CS, Hsiao GYW, Yang JC*. The Antibacterial Efficacy and In Vivo Toxicity of Sodium Hypochlorite and Electrolyzed Oxidizing (EO) Water-Based Endodontic Irrigating Solutions. Materials, 13(2), 2020. (2.972/34.8%).
4. Aditi Pandey, Chun-Liang Kuo, Chia-Jung Liang, Liang-Yu Chang, Chieh-Yun Hsu, Sheng-Yang Lee, Nai-Chia Teng, Jen-Chang Yang*. 3D Pore-Interconnected Calcium Phosphate Bone Blocks for Bone Tissue Engineering. Ceramic International. March 25, 2020, 46 (2020) 16465–16471. (3.450/7.1%)

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YI-PING CHEN : NANO THERANOSTICS

Major Research Aims

Multifunctional mesoporous silica nanoparticle (MSN) has become a promising and widely applicable platform for different biomedical applications on bioimaging, biosensing, drug delivery, and so on. Our groups aim to design an ideal MSN for use in vivo to achieve the characteristics of biocompatible, stability, and not accumulate in organs after administration. Our research interests lie in the nanoscale therapeutics and diagnostics focused on the approach to deliver protein or antibody into cells using silica nanoparticle strategies for enzyme replacement therapy (ERT) and targeting therapy. The results include: (1) denatured proteins conjugated onto MSN are capable of refolding and enhancing delivery efficiency because of decreasing steric hindrance, followed by an activation of enzyme that triggers a cascade reaction, leading it to prevent ROS induced cell death; (2) a MSN-antibody complex is employed to catch the Rel protein (NF-κB p65) in perinuclear region thus blocking the translocation near the nuclear pore gate because the size of the p65 bound nanoparticle becomes too big to enter nucleus. We expect our studies would push the nano carrier into preclinical, as well as attempt to address the current developmental and therapeutic challenges.

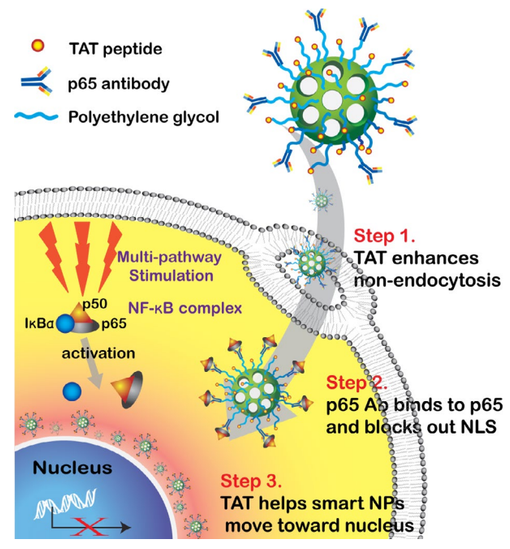
Yi-Ping Chen, Ph.D.,
Assistant Professor

Major Achievements

1. Developed biocompatible and therapeutic MSN applied in medicine, especially in cancer and neurodegenerative disease.
2. Investigated enzyme replacement therapy (ERT) using MSN-based protein delivery strategies .
3. Designed MSN as a smart antibody-targeting nanoparticle to block nuclear translocation of the activated NF- κB p65 for cancer therapy
4. Conjugated biological peptides onto MSN, which enhanced tumor targeting, intracellular uptake, and lysosomal targeting.

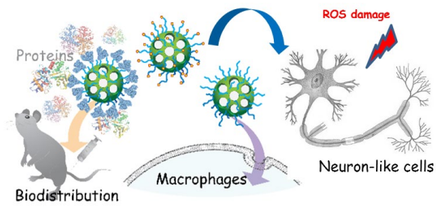
Representative Figures

1.



1. Catcher in the Rel: Nanoparticles-antibody conjugate as NF-κB nuclear translocation blocker.
2. Impacts of protein corona on biological effects of mesoporous silica nanoparticles.
3. Peptide-mediated delivery of pH-sensing mesoporous silica nanoparticles into lysosome in living cells.

2.



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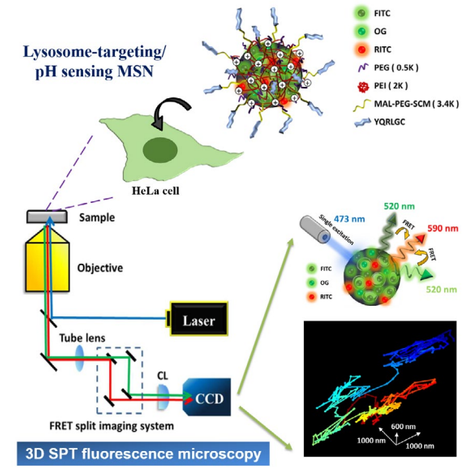

Major Publications

1. Chen YP, Chen CT, Hung Y, et al. A new strategy for intracellular delivery of enzyme using mesoporous silica nanoparticles: superoxide dismutase. J. Am. Chem. Soc. 2013; 135, 1516-23.
2. Chen YP, Wu CH, Wu SH, et al. Enhanced non-endocytosis cellular uptake of medium-size mesoporous silica nanoparticles by shortening the peptide transporter arginine side chain. ACS Appl. Mater. Interfaces 2013; 5, 12244–48.
3. Chang FP, Chen YP, and Mou CY. Intracellular implantation of enzymes in hollow silica nanospheres for protein therapy: cascade system of superoxide dismutase and catalase. Small 2014; 10, 4785-95.
4. Lin YH, Chen YP*, Liu TP, et al. Approach to deliver two antioxidant enzymes with mesoporous silica nanoparticles into cells. ACS Appl. Mater. Interfaces 2016; 8, 17944-54.
5. Chen YP, Wu SH, Chen IC, et al. Impacts of crosslinkers on biological effects of mesoporous silica nanoparticles. ACS Appl. Mater. Interfaces 2017; 9, 10254-265.

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TMU BIOMEDICAL ENGINEERING RESEARCH TEAM

TSUNG-RONG KUO : NANOMATERIALS & NANOTECHNOLOGY

Tsung-Rong Kuo, Ph.D.,
Associate Professor

Major Research Aims

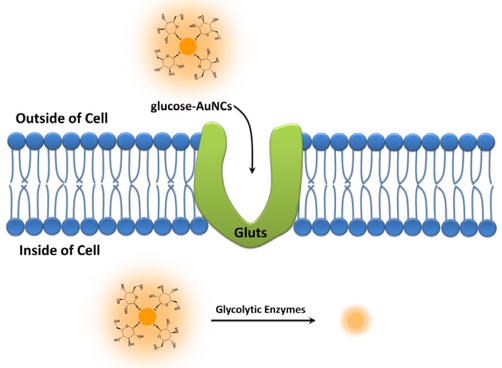
The metabolic mechanism of nanomaterials in bacteria is a crucial piece of information for evaluation of antibacterial efficacy of nanomaterial-based antibacterial agent. In our research team, metal nanoclusters have been developed to study their metabolic mechanisms and antibacterial activity in bacteria. The metabolic kinetics of metal nanoclusters have been investigated by their fluorescence changes in bacteria. Furthermore, with a better understanding of the metabolic mechanism of metal nanoclusters in bacteria can help us to design the high performance photosynthetic biohybrid systems (PBSs). Therefore, in our research team, PBSs with the uses of metal nanoclusters and bacteria have been also investigated and applied to harvest solar energy and then the solar energy has been transferred into CO2-derived chemicals by taking advantage of the metabolic pathways in living organisms. Eventually, we hope that we will be able to develop a practical PBS with the uses of metal nanoclusters and bacteria.

Major Achievements

1. Quantitative analysis of glucose metabolic cleavage in glucose transporters overexpressed cancer cells by target-specific fluorescent gold nanoclusters.
2. Metabolic mechanism investigation of antibacterial active cysteine-conjugated gold nanoclusters in *Escherichia coli.*
3. Light-activated heterostructured nanomaterials for antibacterial applications.
4. Development of high-performance artificial photosynthetic biohybrid systems based on metal nanoclusters and bacteria.

Representative Figures

1.



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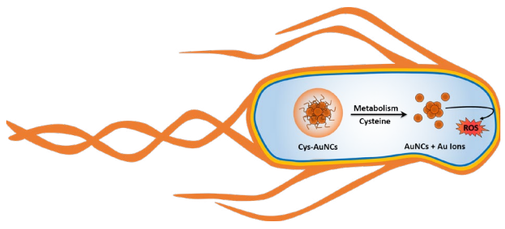

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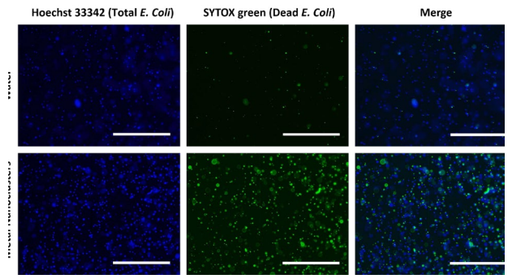

1. Schematic illustration of glucose conjugated gold nanoclusters as a fluorescent probe for glucose transporters overexpressed cancer cells.
2. Schematic illustration of the metabolism of cysteine conjugated gold nanoclusters in E. coli and the significant intracellular ROS generation induced by the nanoclusters to kill E. coli due to lack of reactive oxygen species scavenger of cysteine.
3. Fluorescence images of cysteine conjugated gold nanoclusters incubation with E. coli. The blue and green pseudocolors represent the fluorescent signals of total E. coli (stained with Hoechst 33342) and dead E. coli (stained with SYTOX green), respectively. With incubation of water, no significant E. coli death was observed in the fluorescence image. In comparison with incubation of cysteine conjugated gold nanoclusters, drastic death of E. coli was revealed in the fluorescence image.

Major Publications

1. Chang TK, Cheng TM, Chu HL, et al. Metabolic Mechanism Investigation of Antibacterial Active Cysteine-Conjugated Gold Nanoclusters in Escherichia coli. ACS Sustain. Chem Eng 2019; 7: 15479-15486.
2. Cheng TM, Chu HL, Lee YC, et al. Quantitative Analysis of Glucose Metabolic Cleavage in Glucose Transporters Overexpressed Cancer Cells by Target-Specific Fluorescent Gold Nanoclusters. Anal Chem 2018; 90:3974-3980.
3. Tung CW, Kuo TR, Hsu CS,et al. Light-Induced Activation of Adaptive Junction for Efficient Solar-Driven Oxygen Evolution: In Situ Unraveling the Interfacial Metal-Silicon Junction. Adv Energy Mater 2019; 9: 1901308.
4. Kuo TR, Lee YC, Chou HL, et al. Plasmon-Enhanced Hydrogen Evolution on Specific Facet of Silver Nanocrystals. Chem Mater 2019; 31:3722-3728.
5. Kuo TR, Liao HJ, Chen YT, et al. Extended visible to near-infrared harvesting of earth-abundant FeS2-TiO2 heterostructures for highly active photocatalytic hydrogen evolution. Green Chem 2018; 20:1640-1647.

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PO-KANG YANG : SMART MATERIALS & DEVICES

Po-Kang Yang, Ph.D.,
Assistant Professor

Major Research Aims

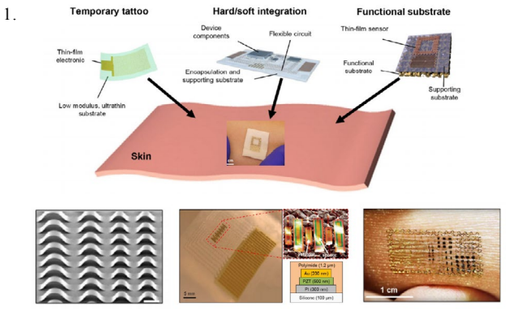
Wearable devices are essential for next-generation micro/nanosystem applications, including healthcare monitoring, medical rehabilitation, athletic training, and outdoor equipments. Conventional wearable devices are mainly powered by batteries and thus challenged by a limited lifetime usage. Energy renewal or battery recharge for the devices is too inconvenient to satisfy the demands for the present consumer markets. To address this issue, the self-powered technology, in which the device's power is supplied by an attached wearable energy harvester, is increasingly attracting attention. The basis of such a self-powered scheme lies in the fact that the energy sources comes from the "ambience". Our researches mainly focus on applying smart materials into developing advanced energy harvesting device, biomedical sensing platforms, and bio-integrated systems, which can pave the way for future human-machine interface, nanomedicine, antibacterial, diagnosis, and even artificial intelligenece applications.

Major Achievements

1. Develop new type sensing platforms, which could be attached to human body to monitor the phyichemical status.
2. Realize the concept of a self-powered healthcare monitoring system, including humidity, sweat and gait phase sensors.
3. Utilize functional materials to build up future wearable biomedical devices.
4. Design renewable, widely-applicable energy harvesting and storage device for future biointerface applications.

Representative Figures

1.



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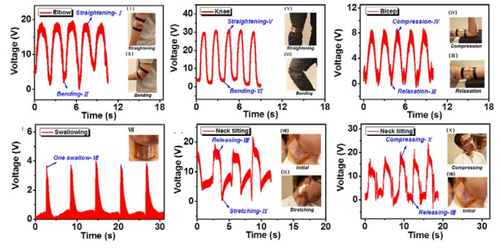

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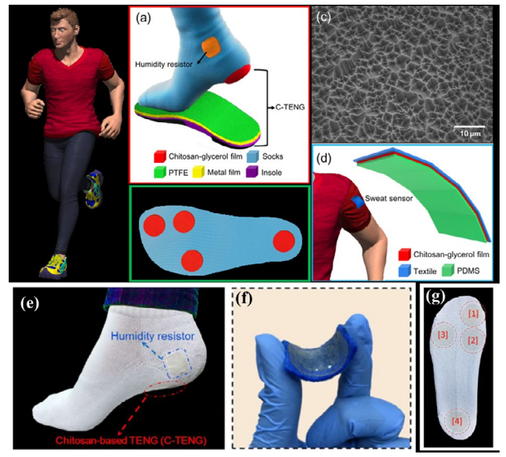

1. Bio-integrated sensing system/platform with advanced semiconductor fabrication process.
2. Multi-functional biomedical sensor design. Relative changes in voltage versus time for monitoring various kinds of human motions.
3. The schematic configuration of (a, b, d) A self-powered humidity sensor, gait phase detector, and sweat sensor. (c) SEM images of the hydrogel surface. (e-g) The corresponded images of the as-fabricated devices.

Major Publications

1. Yang, P.-K.; Chang, W.-Y.; Teng, P.-Y.; Jeng, S.-F.; Lin, S.-J.; Chiu, P.-W.; He, J.-H. "Fully transparent resistive memory employing graphene electrodes for eliminating undesired surface effects," Proc. IEEE 2013, 101, 1732–1739.
2. Yang, P.-K.; Lin, L.; Yi, F.; Li, X.; Pradel, K.; Zi, Y.; Wu, C.-I.; He, J.-H.; Zhang, Y.; Wang, Z. L. "A Flexible, Stretchable and Shape-Adaptive Approach for Versatile Energy Conversion and Self-Powered Biomedical Monitoring," Adv. Mater., 2015, 27, 3817-3824..
3. Jao, Y.-T.; Yang, P.-K.; Chiu, C.-M.; Lin, Y.-J.; Chen, S.-W.; Lin, Z.-H. "A Textile-based Triboelectric Nanogenerator with Humidity-Resistant Output Characteristic and its Applications in Self-Powered Healthcare Sensors," Nano Energy 2018, 50, 513-520. (*co-first author).

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SI-HAN WU : HYBRID SILICA

Si-Han Wu, Ph.D.,
Assistant Professor

Major Research Aims

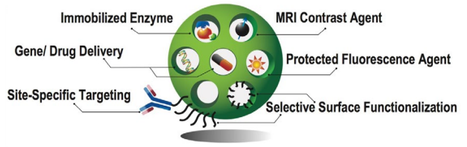
Nanomedicine is promising and capable of integrating therapeutics with nanocarriers to improve treatment for cancers. However, a review paper published recently in Nature Reviews Materials highlighted that only 0.7% (median) of a systemically administrated dose of nanoparticle-based drugs ends up in the tumor, and the targeting efficiency has not been improved in the past ten years. In addition, hypoxia is crucially involved in tumor progression, resulting in resistance to cancer therapy. Consequently, efforts only focus on solving one issue at a time is not enough to meet the emerging field of nanomedicine. Mesoporous and hollow silica nanoparticles (MSN/HSN) are intriguing nanocarriers for efficient and cell-specific delivery of proteins, enzymes, and anti-cancer drugs to improve treatment of diseases. However, despite often highly promising in vitro findings, such as enhanced uptake and intracellular processing as well as efficacy, practical applications of MSN/HSN are usually limited due to poor stability, serious aggregation and short in vivo circulation lifetimes in biological media. Our research is aimed towards clarifying the relationship between synthetic identity and physiological responses, with a focus on developing clinically translatable MSN/HSN-based nanomedicine to eradicate hypoxic tumor cells.

Major Achievements

1. The first report of directly injecting MSN into mice and in vivo visualizing the localization of MSN via MRI.
2. The first report of utilizing a microemulsion system to fabricate uniform HSN, which can encapsulate both organic and inorganic materials for biological and catalytic reactions.
3. Investigation of size, charge and cross-linkers effects of MSN on biological responses in cells, zebrafish, and mice.
4. Development of compartmentalized HSN for encapsulating both hydrophobic and hydrophilic molecules.
5. Development of highly dispersed PEGylated silica nanoparticles in physiological media for tumor targeting.

Representative Figures

1.



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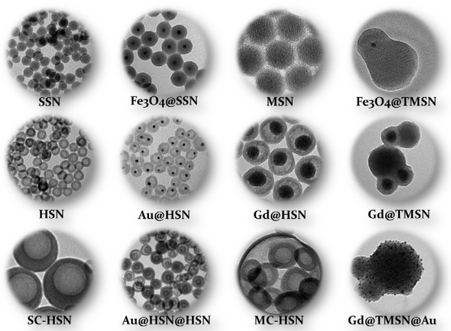

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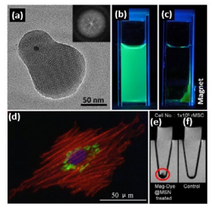

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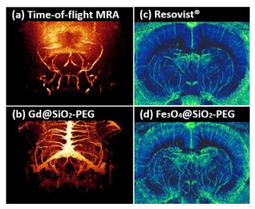

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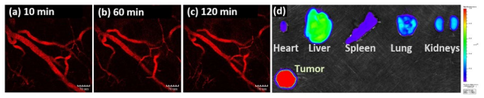

1. Biological applications of porous silica nano-platform.
2. TEM images of various hybrid silica nanoparticles.
3. (a) TEM and (b) photographs of Mag-Dye@MSN after UV-light irradiation and (c) magnetic capture; (d) confocal image of Mag-Dye@MSN in rMSC cells; (e-f) T2-weighted MR images of rMSC.
4. (a) Time-of-flight magnetic resonance angiography (MRA) images of vasculature in rat brains; (b) contrast-enhanced MRA with Gd@SiO2-PEG; (c) volume rendering 3DΔR2-mMRA of Resovist® and (d) Fe3O4@SiO2-PEG.
5. (a-c) Time-dependent two-photon fluorescent images of PEGylated MSN in blood circulation; (d) Ex vivo IVIS images 24h post-injections of PEGylated MSN into a tumor-bearing mouse.

Major Publications

1. Wu SH, Hung Y, Mou CY. Mesoporous Silica Nanoparticles as Nanocarriers. Chem. Commun. 2011, 47, 9972-9985.
2. Wu SH, Hung Y, Mou CY. Compartmentalized Hollow Silica Nanospheres Templated from Nanoemulsions. Chem. Mater. 2013, 25, 352-364.
3. Wu SH, MouCY, Lin HP. Synthesis of Mesoporous Silica Nanoparticles. Chem. Soc. Rev. 2013, 42, 3862-3875.
4. Liu TP, Wu SH, Chen YP, Chou CM, Chen CT. Biosafety Evaluations of Well-Dispersed Mesoporous Silica Nanoparticles: Towards in Vivo-Relevant Conditions. Nanoscale, 2015, 7, 6471-6480.
5. Chen YP, Wu SH, Chen IC, Chen CT. Impacts of Cross-Linkers on Biological Effects of Mesoporous Silica Nanoparticles. ACS Appl. Mater. Inter. 2017, 9, 10254–10265. (*co-first author)

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CHIH-HSIN (MELODY) LIN : TISSUE ENGINEERING

Chih-Hsin Lin, Ph.D.,
Assistant Professor

Major Research Aims

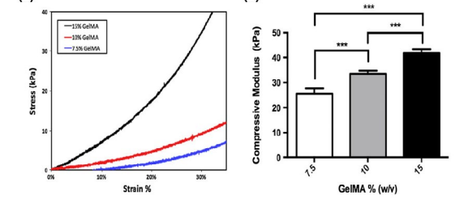
Although there are many drug screening methods, only very few drugs meet requirement by the US Food & Drug Administration for clinical use. Many studies attempted to develop a platform for drug screening, but only provided limited information due to the difficulty of mimicking real human tissue and their drug response. Here, we proposed to use 3D bioprinting technology to fabricate a 3D engineered liver tissue construct with integrated functional vessels for drug discovery application. Using this new approach, the timeframe of drug discovery can be shortened, and better predict human tissue response. Creating an effective drug screening platform will likely make a significant impact and help accelerate new drug discovery. This work has a great potential to provide a useful method that can mimic a realistic human liver tissue, and enable high throughput drug library screening or chemical compound screening, and in the future can even be used for for transplantation.

Major Achievements

1. Creating a 3D culture system for endothelial differentiation from bone marrow mesenchymal stem cells using a new light-cured gelatin methacrylate (GelMA) hydrogel for bioprinting and dental clinical applications.
2. Fabricating liver tissue with integrated vasculature, by combining bioprinting and liver tissue slices, to develop a high throughput system for drug screening.
3. 3D printed gelatin scaffold with adipose stem cells, endothelial colony forming cells and negative pressure for vascularized adipose tissue.

Representative Figures

1.



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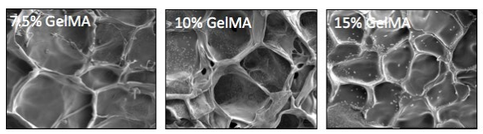

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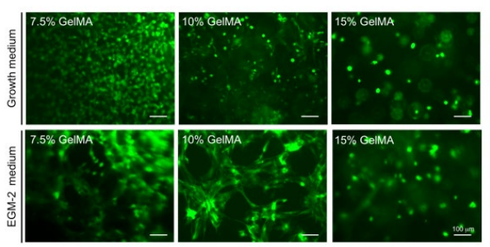

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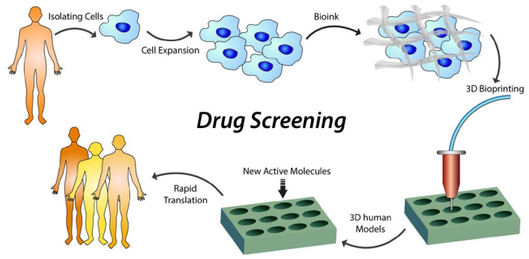

1. Mechanical properties of GelMA at different concentrations. Stress-strain curves (a) and compressive modulus (b) for 7.5%, 10%, and 15% (w/v) GelMA.
2. Electron microscope images of freeze-dried GelMA hydrogel surfaces at different concentrations (7/5%, 10%, and 15%).
3. Fluorescent images of LIVE/DEAD assays of MSCs photoencapsulated using either growth medium or EGM-2 and different GelMA concentrations (7/5%, 10%, and 15%).
3. Scheme of 3D printed liver tissue with integrated vasculature for drug screening application.

Major Publications

1. Lin CH, Lin YM, Chen CY, et al. Mechanical property, accuracy and cytotoxicity of the UV-cured 3D printing resins composed of BisEMA, UDMA and/or TEGDMA. J Prosthet Dent 2019; 123: 349-354.
2. Lin CH, Su Jimmy, Lee SY, et al. Stiffness modification of photopolymerizable gelatin-methacrylate hydrogels influences endothelial differentiation of human mesenchymal stem cells. J Tissue Eng Regen Med 2018; 1-13.
3. Lin CH, Lin LH, Chang MC, et al. Bioactive surface modification of polycaprolactone using MG63-conditioned medium can induce osteogenic differentiation of mesenchymal stem cells. J Mater Sci 2017; 52: 3967-3978.
4. Lin CH, Lin YY, Lin KF, et al. Antioxidant N-acetylcysteine and glutathione increase the viability and proliferation of MG63 cells encapsulated in the gelatin-methacrylate/VA086/blue light hydrogel system. Tissue Eng Part C 2016; 22: 792-800.
5. Lin CH, Lee SY, Lin YM. Plasma treatment in conjunction with EGM-2 medium increases endothelial and osteogenic marker expressions of bone marrow mesenchymal stem cells. J Mater Sci 2016; 51:9145-9154.

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MING-HONG CHEN :
SPINE RECONSTRUCTION AND NEURAL ENGINEERING

Major Research Aims

The TMU research team in spine reconstruction and neural engineering focuses on topics related to (A) the mechanisms of spine degeneration and reconstruction of the spine, and (B) the applications of tissue engineering and nanotechnology in the diseases of the nervous system. In the past, not only have we discovered the mechanotransduction and metabolic processes of extracellular matrices associated with the degeneration of the spine's yellow ligament and intervertebral disc, but also, we have innovated techniques to prevent post-surgery epidural adhesion using the foundations of functional biomaterial and tissue engineering. In working with the industry, we have investigated and developed an array of applications for implants during spine reconstruction surgery. Other research focuses of our team include the development of the axonal guidance and regeneration capabilities of functional biomaterials.

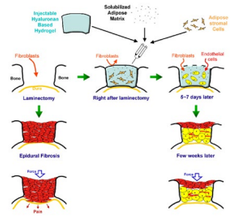
Ming-Hong Chen, M.D., Ph.D.
Associate Professor

Major Achievements

1. Development of an injectable extracellular matrix for the reconstruction of epidural fat and the prevention of epidural fibrosis.
2. In situ forming hydrogel composed of hyaluronate and polygalacturonic acid for prevention of peridural fibrosis.
3. One-stop radiotherapeutic targeting of primary and distant osteosarcoma to inhibit cancer progression and metastasis using 2DG-grafted graphene quantum dots.
4. Low-intensity pulsed ultrasound stimulates matrix metabolism of human annulus fibrosus cells mediated by transforming growth factor β1 and extracellular signal-regulated kinase pathway.

Representative Figures

1.



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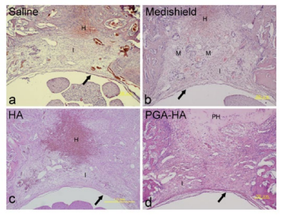

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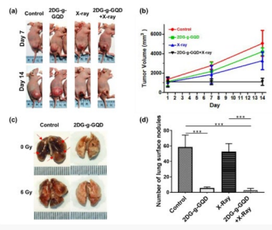

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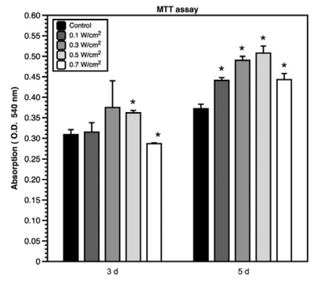

1. A simple schematic illustration of the potential mechanism whereby ASCs loaded into a DAM-containing HA hydrogel can prevent epidural fibrosis.
2. Axial microscopical sections from vertebral column 1 week after laminectomy. (a) Saline group (b) Medishield group (c) HA hydrogel group (d) PGA– HA hydrogel group. Notice that hematomas (H) could be found in the saline, Medishield, and HA hydrogel groups. Significant amount of PGA–HA hydrogel (PH) did not degrade.
3. Therapeutic efficacy and metastasis inhibition of control, 2DG-g-GQDs (20 mg kg-1), X-ray radiation (6 Gy), and the combination treatment.
4. Effects of LIPUS of different intensities on the AF cells. The results showed that the viability of AF cells increased with 0.5 W/cm2 LIPUS 3 days and 5 days after pulsed ultrasound stimulation.

Major Publications

1. Tung FI, Zheng LJ, Hou KT, Chiang CS, Chen MH, Liu TY. One-stop radiotherapeutic targeting of primary and distant osteosarcoma to inhibit cancer progression and metastasis using 2DG-grafted graphene quantum dots. Nanoscale. 2020 Apr 6.
2. Chang YC, Chen MH, Liao SY, Wu HC, Kuan CH, Sun JS, Wang TW. Multichanneled Nerve Guidance Conduit with Spatial Gradients of Neurotrophic Factors and Oriented Nanotopography for Repairing the Peripheral Nervous System. ACS Appl Mater Interfaces. 2017 Nov.
3. Chen MH, Chen JY. A Novel Nonpedicular Screw-Based Fixation in Lumbar Spondylolisthesis. Biomed Res Int. 2017;2017:5619350.
4. Lin CY, Liu TY, Chen MH, Sun JS, Chen MH. An injectable extracellular matrix for the reconstruction of epidural fat and the prevention of epidural fibrosis. Biomed Mater. 2016 Jun 7;11(3):035010.
5. Chen HP, Tung FI, Chen MH, Liu TY. A magnetic vehicle realized tumor cell-targeted radiotherapy using low-dose radiation. J Control Release. 2016 Mar 28;226:182-92

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HAW-MING HUANG :
BIOELECTROMAGNETICS AND RELATED MATERIALS

Major Research Aims

As the static magnetic field (SMF) can re-orientate liquid crystal molecules, the membrane should be affected by external SMFs. This effect induces the membrane distortion, as well as mechanotransduction pathway across the membrane. The deformation of the lipid bilayer affects membrane proteins, such as growth factor receptors and ion channels and account for changing the regulatory functions for growth factors and the rate of cell proliferation and differentiation. In addition, since the cytotoxicity material, such as LPS, also can not bind to its receptor, SMF exposure can be used as a physical resource to attenuate LPS-induced immune host response. Furthermore, SMF affects the alignment of phospholipids results in the increase of membrane rigidity. According to these rational, the research topics of Bioelectromagnetic and Material Research Team focused on the researches of biological effect of SMFs as well as the new biomaterial development using nano-magnetic particles.

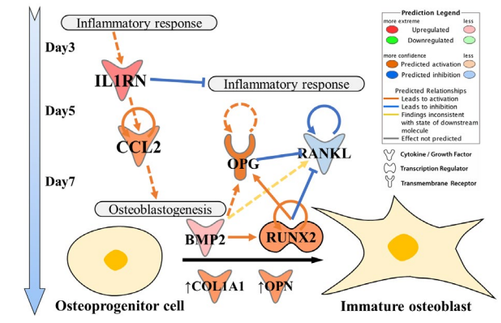
Haw-Ming Huang, Ph.D.,
Professor

Major Achievements

1. Develop a novel radiopaque, biodegradable, and 3D printable bone screw.
2. SMF pretreatment before LPS challenge reduced tissue damage.
3. SMF coupled with the slow cooling procedure increased survival rates of frozen-thawed erythrocytes.
4. The proliferation of stem cells enhanced by the SMF is considered as a model of the p38 MAPK signalling pathway.
5. The proliferation of stem cells enhanced by the SMF is considered as a model of the p38 MAPK signalling pathway.
6. Damping factor analysis can be used as a tool to evaluate the healing process of osseointegration.
7. Develop a novel electrical impedance biochip used for point-of-care whole blood clotting time detection.

Representative Figures

1.



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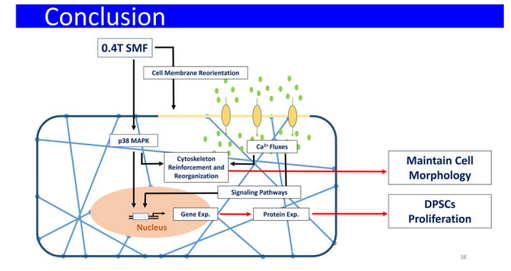

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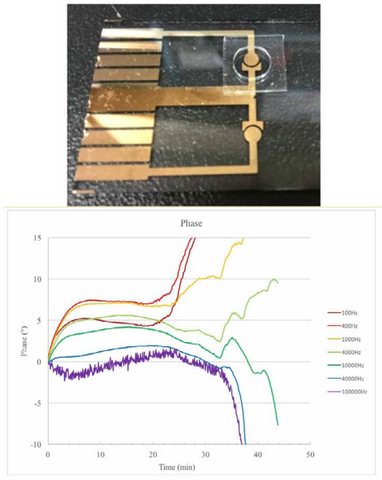

1. The suggested signal pathway of human dentin powder-stimulated IL1RN-CCL2 mediation of osteoblastogenesis. The CCL2 gene predominated in osteoblastogenesis toward immature osteoblast development..
2. The structure of the membrane was affected by the SMF, with a subsequent increase in calcium ion influx. At the same time, the p38 MAPK pathway was activated, and the cytoskeleton underwent reorganization in association with the calcium ions..
3. POC whole blood clotting time detecting chip and the measured signals

Major Publications

1. Huang YC, Lew WZ, Feng SW et al. Histomorphometric and transcriptome evaluation of early healing bone treated with a novel human particulate dentin powder. Biomed Mat 2016; 12:015004.
2. Wang HT, Chiang PC, Tzeng JJ et al. In vitro biocompatibility, radiopacity, and physical property tests of nano-Fe3O4 incorporated poly-l-lactide Bone Screws. Polymers 2017; 9:191.
3. Feng SW, Ho KN, Chan YH et al. Damping factor as a diagnostic parameter for assessment of osseointegration during the dental implant healing process: an experimental study in rabbits. Ann Biomed Eng 2016;44:3668-3678.
4. Lew WZ, Huang YC, Huang KY et al. Static magnetic fields enhance dental pulp stem cell proliferation by activating the p38 MAPK pathway as its putative mechanism. J Tissue Eng Regen Med 2018; 12:19-29.
5. Lew WZ, Feng SW, Lin CT et al. Use of 0.4-Tesla static magnetic field to promote reparative dentin formation of dental pulp stems cells through activation of p38 MAPK signaling pathway. 2018, Int Endod J 2018 (in press)

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TMU BIOMEDICAL ENGINEERING RESEARCH TEAM

LI-CHERN PAN : MICROFLUIDIC BIOCHIPS

Li-Chern Pan, Ph.D.,
Associate Professor

Major Research Aims

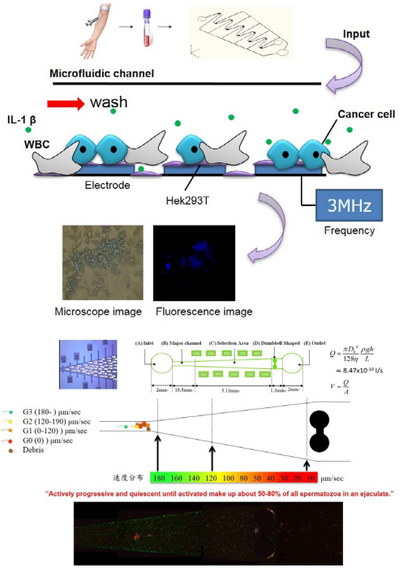
Our lab focuses on the design and development of novel microfluidic biochips for the acquisition of rare biological entities, which has shown advantages over traditional centrifugation-based methods. For example, we have been able to isolate Circulating Tumor Cells (CTCs) using a patented cell-based auto-adherence method, as well as developing a high throughput acquisition assay for sorting progressive spermatozoa. We have made sure to integrate the intrinsic physiological properties of the target biological entities along with the microfluidic flow design. Therefore, we are often able to isolate rare, live cells with minimal damage to their morphology or DNA. To increase the clinical applicability of these new technologies, our laboratory has implemented FDA-compatible protocols relating to the bio-compatibility of our glass-based bio chips. This will allow us to realize the academic research and improve the commercialization of MEMS-based bio chip devices.

Major Achievements

1. High Throughput Sorting of Progressive Motile Sperms from Raw Semen.
2. FDA Biocompatibility Accessibility for Microfluidic Devices.
3. Method for Auto-adherence-based Capture and Analysis of Circulating Tumor Cells.
4. Non-centrifugal Removal Method for Low Damage Blood Sample Purification.
5. Design Microfluidic Automatic Dispenser and Diagnosis Systems.

Representative Figures

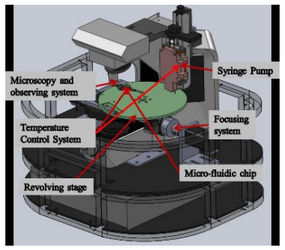
1.



2.

"Actively progressive and quiescent until activated make up about 50-80% of all spermatozoa in an ejaculate."

3.



4.

Original count (0 hr):

COUNT SUMMARY

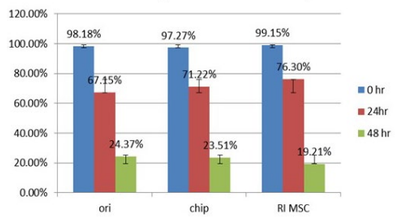
Category	Cells Counted	Sample (M)	Concentration (M/ml)	Percent
Total	1770	0.0	30.3	100
Motile	1694	0.0	29.0	96
Progressive	1142	0.0	19.6	65

Chip count (24 hr):

COUNT SUMMARY

Category	Cells Counted	Sample (M)	Concentration (M/ml)	Percent
Total	283	0.0	4.5	100
Motile	252	0.0	4.0	89
Progressive	233	0.0	3.7	82

Human Sperm Survial Assay



Major Publications

1. Chen YC, Pan LC, Lai CW, Chien YS, Wu TH. Silymarin and protein kinase A inhibitor modulate glucose-mediated mouse sperm motility: An in vitro study. Reproductive biology 2015, 15 (3), 172-177.
2. Pan LC, Hsu FC, Yu WS, Lin YL, Tseng FG, Wang CW, Tzeng CR. Sorting of sperms with reverse progressive characteristic may provide another option for acquiring spermatozoa with significant improvement in fertility related quality for patients with oligospermia. Fertility and Sterility 2014, 102 (3), e353-e354.
3. Pan LC, Liu SY, Yen CC, Hsiu HW, Wang CW, Tzeng CR. Preliminary evaluation of methylcellulose as an alternative rate control medium for the acquiring of high quality spermatozoa in swim-up. Fertility and Sterility 2013, 100 (3), S453.

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TZU-SEN YANG : 5206 MOLECULAR DYNAMICS LABORATORY

Tzu-Sen Yang, Ph.D.,
Associate Professor

Major Research Aims

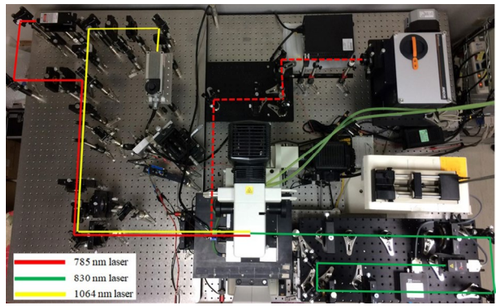
Probing the structure, dynamics, and mechanisms of live-cell systems is fundamental to a quantitative understanding of how biological systems function. Recently, single-molecule techniques including optical tweezers and single-molecule fluorescence microscopy have developed into a widely used method for application in living cells. In addition, surface functionalization and bioconjugation of nanoparticles, e.g., quantum dots, silver nanoparticle, and gold nanoparticles, are attractive for many biomedical applications such as imaging, therapeutics and diagnostics. We have combined optical tweezers, single-molecule fluorescence detection, temperature control system, microfluidics, micro-scale surface enhanced Raman spectroscopy (μSERS) system, and laser-assisted cell printing technique for the construction of versatile biophotonics platform for biomedical applications at the single cell level. We have utilized this six-in-one integrated biophotonics platform to conduct visualization of the effect of the EGFR tyrosine kinase inhibitor PD153035 on cell locomotion, probing the amphotericin B induced permeability changes across ergosterol-containing membrane, disinfection effects of silver-doped ceria nanoparticles, and combined photothermal and surface-enhanced Raman spectroscopy using gold nanoparticles.

Major Achievements

1. Single-molecule dynamics of DNA-drug interactions.
2. Disinfection effects of silver-doped ceria nanoparticles.
3. Single-cell NF-kB dynamics.
4. Effect of low level laser therapy on mitochondrial function and biphasic dose response.
5. Development of laser-assisted bioprinting techniques.

Representative Figures

1.



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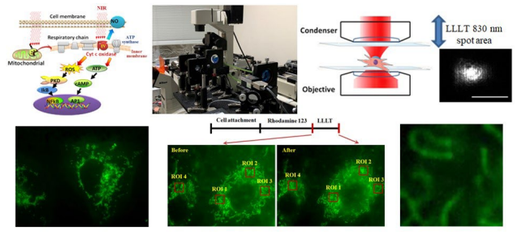
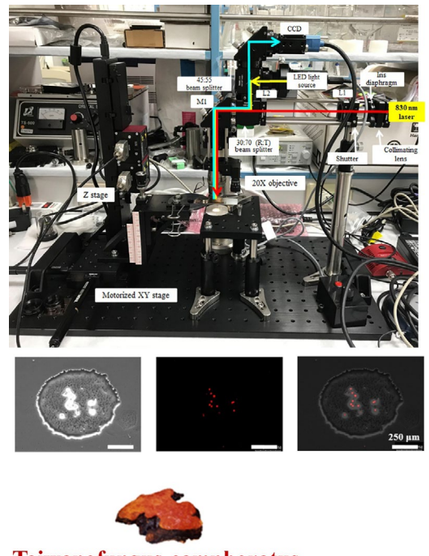


1. Platform for single-cell manipulation and detection.
2. A single-cell study of mitochondrial function and biphasic dose response in low level laser therapy.
3. High spatial-resolution laser induced forward transfer (LIFT)-based bioprinting system.
4. Quantifying membrane permeability of amphotericin B ion channels in single living cells.

3.



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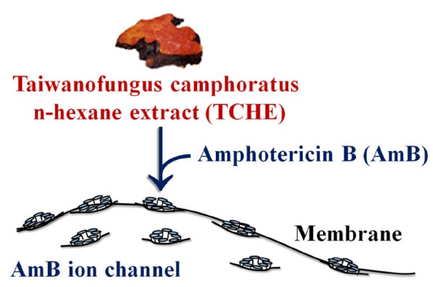

Major Publications

1. Huang CF, Colley M S, Lu LS, Chang CY, Peng PW and Yang TS. Performance characterization of continuous-wave laser-induced forward transfer of liquid bioink. Applied Physics Express. (2019) 12(11): 116504.
2. Tsai DS, Yang TS, Huang YS, et al. Disinfection effects of undoped and silver-doped ceria powders of nanometer crystallite size. International Journal of Nanomedicine. (2016) (11):2531-2542.
3. Yang TS, Ou KL, Peng PW, et al. Quantifying membrane permeability of amphotericin B ion channels in single living cells Biochim Biophys Acta-Biomembranes 2013(1828):1794-1801.
4. Cheng CM, Lee YJ, Wang WT, et al. Determining the Binding Affinity Constant of Tyrosine Kinase Inhibitor PD153035 to DNA Using Optical Tweezers Biochemical and Biophysical Research Communications 2011(404):297-301.

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TMU BIOMEDICAL ENGINEERING RESEARCH TEAM

YU-CHENG HSIAO : PHOTONICS AND SOFT MATTERS

Yu-Cheng Hsiao, Ph.D.,
Assistant Professor

Major Research Aims

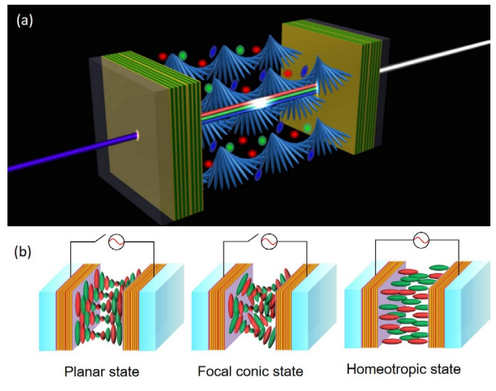
We focus on biosensors and applications of photonics, materials, soft matters, and novel liquid-crystals devices in TMU research team. In addition, we also try to use the optical technology to improve the biomedical field. Prof. Hsiao's expertise is in experimental physics for chiral soft matter, such as cholesteric and blue phase liquid crystals. A demand of green technology devices and biosensors inspired. In recent years. We have shown experimentally a variety of application possibilities using the frontier concepts: 1. Bistable dual-frequency liquid crystals: Fast-switching bistable cholesteric intensity modulator. 2. Electrohydrodynamic instabilities: Polymer stabilization of electrohydrodynamic instability in non-iridescent cholesteric thin films. 3. Photonic crystal spectral manipulations: Electro-optical device based on photonic structure with a dual-frequency cholesteric liquid crystal. 4. Biosensors: Highly sensitive color-indicating and quantitative biosensor based on cholesteric liquid crystal. We try to continue making contributions to this intriguing research areas.

Major Achievements

1. Electrically switchable organo–inorganic hybrid for a white-light laser source.
2. Red, Green, and Blue Reflections Enabled in an Electrically Tunable Helical Superstructure.
3. Highly sensitive color-indicating and quantitative biosensor based on cholesteric liquid crystal.
4. Electrically active nanoantenna array enabled by varying the molecular orientation of an interfaced liquid crystal
5. Liquid crystal-based tunable photonic crystals for pulse compression and signal enhancement in multiphoton fluorescence.

Representative Figures

1.



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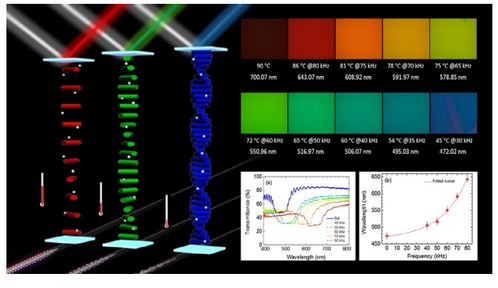

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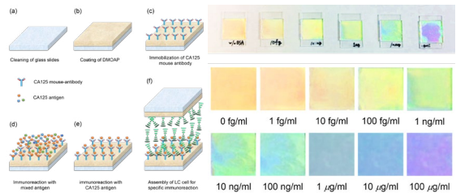

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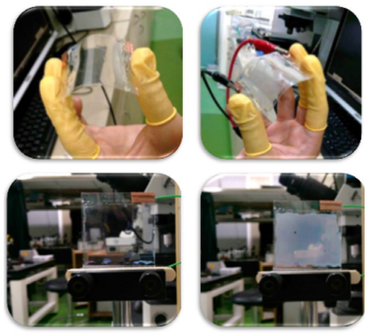

1. Schematics of (a) the CPC and (b) the corresponding configurations of the three CLC states. The red and green ellipsoids represent the dye and the LC molecules, respectively.
2. Colors of a DFTC materials derived from various frequencies at the fixed applied voltage.
3. Representative VAC cells featuring the color-indicating properties of the VAC biosensor at different BSA concentrations.
4. Photographs of the fast-switching bistable cholesteric device in the planar state and the focal conic state at null voltage.

Major Publications

1. Hsiao YC. Liquid crystal-based tunable photonic crystals for pulse compression and signal enhancement in multiphoton fluorescence. Opt. Mater. Express 2016, 6 (6), 1929-1934.
2. Hsiao YC, Su CW, Yang ZH, Cheypesh YI, Yang JH, Reshetnyak VY, Chen KP, Lee W. Electrically active nanoantenna array enabled by varying the molecular orientation of an interfaced liquid crystal. RSC Advances 2016, 6 (87), 84500-84504.
3. Hsiao YC, Sung YC, Lee MJ, Lee W. Highly sensitive color-indicating and quantitative biosensor based on cholesteric liquid crystal. Biomed. Opt. Express 2015, 6 (12), 5033-5038.
4. Hsiao YC, Yang ZH, Shen D, Lee W. Red, Green, and Blue Reflections Enabled in an Electrically Tunable Helical Superstructure. Advanced Optical Materials 2018, 6 (5), 1701128.
5. Huang JC, Hsiao YC, Lin YT, Lee CR, Lee W. Electrically switchable organo–inorganic hybrid for a white-light laser source. Scientific Reports 2016, 6, 28363.

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DAVID WILLIAM GREEN : BIOMIMETICS AND BIOINSPIRED ENGINEERING

David William Green,
Ph.D.,Associate Professor

Major Research Aims

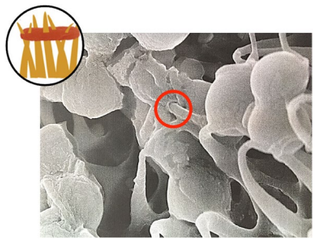
Bioengineered materials, structures, and devices are extensively used for tissue medicine as vital frameworks for proper cell and tissue growth into clinically viable replacements for all the major organs. However, most biomaterials lack essential aspects of natural spatial and temporal complexity, as well as miniaturization. Besides, the artificially engineered tissues are only generatable in small volumes, which limits their clinical applicability and relevance. Our undertaking is to tackle the complexity problem. In doing so, we generate biomaterials with more numerous and more sophisticated bio interactions and bio-integration. Replicating natural biomaterial complexity requires that we use nature's raw materials, nanoscale design and synthesis, and microscale assembly and self-organization processes to create highly functional biomaterials. Our primary research theme is biomimetic materials chemistry in which we copy the chemical syntheses that give rise to complex forms of material. Such bioinspired and biomimetic approaches motivate and drives the research and development of numerous innovative materials and structures applicable to every facet of regenerative medicine. Our latest endeavor is to harness smart semi-synthetic protocells and prototissues to support and steer tissue formation into therapeutic microtissues for the clinic.

Major Achievements

1. Development of several invertebrate frameworks for tissue engineering applications, improving in vivo bone tissue formation.
2. Original application of biomimetic materials chemistry to biomaterials fabrication for regenerative medicine. This has inspired the generation of biomimetic bone void particles based on Coccoliths, nacre-like bone implant coatings, eggshell coated capsules for cell and protein delivery, amino acid modified bioceramic stem cell coatings for specialisation, Dentine analogues and coral mimicking bioceramics for bone replacement.
3. Translation of nature-inspired surface nanotopographies into bactericidal membranes and films for dentistry and healthcare.
4. Droplet based biomaterials for self-automated pluripotent cell reprogramming and selective specialization.
5. First development of synthetic and semi-synthetic prototissues for application in regenerative medicine.

Representative Figures

1.



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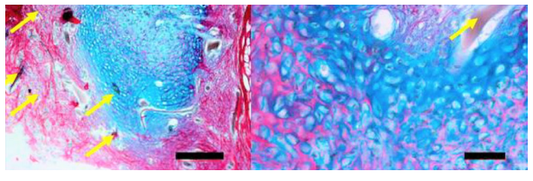

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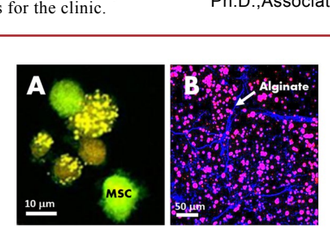

1. SEM image of Gecko spinule (5 nm tip; 200 μm mid-diameter) damage to MRSA bacteria leading to destruction (Top left cartoon showing the puncturing of a single bacteria).
2. Histological thin section of *de novo* human bone and cartilage generation inside an implanted collagenous marine sponge framework (Scale bar= 200 μm).
3. Fluorescence images of (A) Alginate and chitosan overlaid microcoating of mesenchymal stem cells; (B) Reprogrammed pluripotent stem cells (purple) inside an alginate droplet (blue) at high efficiencies by transfer of co-encapsulated small molecule analogues of "*Reversine*"; (C) Cross-section through an alginate droplet deposited inside a living calvarial defect showing bone formation (rusty orange) from fibroblasts infused with a combination of reprogramming (Programin™) and differentiation factors (rhBMP-2).

Major Publications

1. Green DW*, GS Watson, J Watson, Stamboulis A. (2020) Sequenced somatic cell reprogramming and differentiation inside nested hydrogel droplets. *Adv Biosyt*; In Press.
2. Green DW*, B. Ben-Nissan, K.S. Yoon, B. Milthorpe, H-S. Jung. (2017) The revitalisation of natural and synthetic coral skeletons for human bone regeneration. *Trends Biotechnol*. 35, 1, 43-54.
3. Xin L, Watson G, Watson J, Cheung G, Green DW*. (2016) The Nanotipped Hairs of Gecko skin and Biotemplated Replicas Impair and/or Rupture Pathogenic Bacteria with High Efficiency. *Nanoscale*. 8, 18860-18869.
4. Green DW*, Gregory Watson, Jolanta Watson, Jung H.-S. (2018) Simulated embryonic and fetal cellular dynamics inside structured biomaterials. *Appl. Mats Today* 11, 291-307
3. Green DW, Kanczler J, Bolland B, Lanham S, Yang XB, Walsh D, Mann S, Oreffo ROC. (2009) Augmentation of skeletal tissue formation in impaction bone grafting using vaterite microsphere biocomposites. *Biomaterials* 30, 10: 1918-1927.
3. Green DW, Leveque I, Walsh D, Howard D, Yang XB, Partridge KA, Mann S, Oreffo ROC. (2005) Biomineralized polysaccharide capsules for encapsulation, organization and delivery of human cell types and growth factors. *Adv. Funct. Mater*. 15, 6, 917-923.

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TMU HEALTHCARE SYSTEM

Taipei Medical University Hospital

Wan-Fang Hospital

Shuang-Ho Hospital

TMU Taipei Neuroscience Institute

TMU Taipei Cancer Center

Hsin Kuo Min Hospital

TMU Healthcare System

About

With a total of 4,123 beds in capacity, TMU Healthcare System will be one of the largest healthcare systems in Metropolitan Taipei. It comprises one medical university and four affiliated hospitals and integrates primary and specialty care with research and education. With the line-up of Taipei Medical University Hospital, Wan Fang Hospital, Shuang Ho Hospital and Hsin Kuo Min Hospital, TMU Healthcare System becomes a heavy weight healthcare provider, which emphasizes the quality of medical service, teaching and clinical researches. TMU Healthcare System continuously strives to improve the quality of medical care and research with the goal of becoming the global healthcare destination.

3 JCI and AAHRRP - Accredited Affiliated Hospitals

Taipei Medical University Hospital

- Est. in 1976
- 800 Beds
- No. of Staff : 1,946
- Cancer Excellent Research Center
  2011 National Quality Award

TMU Taipei Neuroscience Institute

- Est. in 2017

Wan-Fang Hospital

- Est. in 1997
- 743 Beds
- No. of Staff : 1,808
- National Drug Evaluation Center
  Emergency Operation Center

TMU Taipei Cancer Center

- Est. in 2018

Shuang-Ho Hospital

- Est. in 2008
- 1,580 Beds
- No. of Staff : 2,109
- Emergency Air Medical Transport
  (EAMT) Hospital 2012 National
  Quality Award

Hsin Kuo Min Hospital

- Est. in 2019

TAIPEI MEDICAL UNIVERSITY HOSPITAL

About

Taipei Medical University Hospital is a nationally recognized health center that serves the community needs as well as those of global guests from every corner of the world. We are a proud member of the JCI family and are dedicated to delivering the most advanced medical treatments available. We are highly committed to our global development and research collaborations on all continents. Our patient first focus is what makes us different and we invite you to experience it.

TMUH in Numbers:

- 800 Beds
- 2300 Employees
- 410 Medical Professionals
- 25 Departments
- 405 Physicians
- 435 Administrators
- 40 Specialities
- 855 Nurses
- 212 Outsourcing Staff

Major Achievements

TMUH has many specialized centers, such as the Reproductive Medicine Center, Weight Management Center, Kidney Center, Bone and Joint Research Center, minimally invasive surgery center and many other diversified international pioneering medical services.
Enhancing the quality and patients' safety has led TMUH to be accredited as the International Safe Hospital by WHO Collaborating Centre on Community Safety Promotion, which is also the first hospital to pass the accreditation in the world. TMUH keeps fulfilling its core value of "high medical service quality' and "patient-centered' approach.

Centers

TMUH has many specialized centers, such as the Reproductive Medicine Center, Weight Management Center, Kidney Center, Bone and Joint Research Center, minimally invasive surgery center and many other diversified international pioneering medical services.

Enhancing the quality and patients' safety has led TMUH to be accredited as the International Safe Hospital by WHO Collaborating Centre on Community Safety Promotion, which is also the first hospital to pass the accreditation in the world. TMUH keeps fulfilling its core value of "high medical service quality' and "patient-centered' approach.

Goals

Our goal as Taipei Medical University's main university-affiliated teaching hospital is to strengthen the qualifications of our entire medical faculty, provide adequate teaching resources, and encourage all our medical staff to be enthusiastic in educating our students. This educational structure will be accomplished by recruiting and providing training to resident doctors, intern doctors, nurses, and other medical staff members under the standards established by the "New Teaching Hospital Accreditation."

Research

In research, we encourage all our medical staff to continue and further their education with either a Master or PhD degree, continue to promote combined research in the field of clinical and basic science, and provide rewards for journal publications and successful research grants.

Vision

We hope that all staff members of Taipei Medical University Hospital understand that they are doing an extraordinary job, and continue to provide excellent patient service as well as making great achievements in teaching and research. This will allow Taipei Medical University Hospital to become the sole preference in hospital selection for the patients, and thus naturally it would be an honor to all university staff, students and alumni.

WAN-FANG HOSPITAL

About

Co-constructed with the Wanfang Hospital Station of the Taipei mass rapid transit system (MRT) Wenhu line (line1), the Hospital has 743 beds and over 300 medical specialists offering comprehensive professional services. Ever since its founding, the hospital has worked for highest attainable quality service to assure that patients receive care of the top standard. It is one of the first Taiwan hospitals to set up an international medical office for providing individualized medical services for patients from the abroad which is more than 38 countries up to now.

Special Medical Care

In order to offer integrated care to patients, other than the dialysis center, cancer center, health management center, nursing home, reproductive medicine center, cosmetic medical service, sport rehabilitation center, laser excimer eye care center, weight control center, we also established different centers with advanced technology on special disease treatment, and to deal with catastrophic/emergency incidents as well as personalized cancer care management to reach the goal of becoming internationally recognized top-class university hospital.

Education and Research

WanFang Hospital Teaching Department adopts the learner-centered approach which aims at nurturing professional knowledge, attitude, and skills for the trainees to provide comprehensive and continuous care to patients. We set up the center for excellent teaching, within which there are units for problem-based learning, evidence-based medicine, clinical skill training. We offer diversified activities such as simulation and clinical skills training, team care training to foster holistic care competence for medical staff.

Other than teaching, we are devoted to comprehensive research areas and integrate basic medicine, biotechnology, medical information technology, quality management with medical and teaching services. Thereby, medical care quality can be improved continuously. We have signed cooperative education agreements with dozens of domestic and overseas medical institutions for conducting academic exchange or medical training. We also cooperate with the top academic research institutions such as the Taiwan National Health Research Institute and the Academia Sinica to strengthen cross-institutional research.

Vision

Taipei Municipal WanFang Hospital is the first public facility managed by private sector in Taipei City Government. Owing to support from all stakeholders and the efforts from all staff, we have proceeded from a local community hospital to medical center in a short time. Teaching, research, service and quality assurance are equally important as the mission of the Hospital. In addition, "Value the Community, Honor the Patients" as well as "Quality of Service Is Our Pride" are our fundamental philosophy and core values. Altogether, these solidify our strong and sustained commitment to carry out the social responsibility to citizens.

SHUANG-HO HOSPITAL

About

Shuang Ho Hospital officially opened on July 1st, 2008, Taipei Medical University

Shuang-Ho Hospital is the first Build-Operate-Transfer (BOT) project (construction / operation / management) commissioned by the Department of Health, Executive Yuan. It has 1,580 beds and is the largest hospital in Taipei County. Now, Shuang-Ho Hospital, Taipei Medical University Hospital, and Taipei Medical University Wan-Fang Hospital form a medical healthcare golden triangle in the Taipei area with a total capacity of 3,000 beds and can support each other whenever needed.

Since our establishment, Shuang Ho Hospital has been moving toward becoming a medical center. But we have not forgotten our mission as a community hospital. Shuang Ho Hospital upholds our belief in "Quality". Since our opening, our quality has been well-recognized. Our medical evaluation performances have been consistently excellent, and have passed the ISO9001, ISO14001, ISO27001 and HIMSS Stage6.0 international certifications. We are also the nation's first hospital to be awarded the Corporate Social Responsibility dual international certification, the JCI accreditation, and awarded "Excellent" in the New Teaching Hospital Accreditation. In 2013, less than 4 years since our opening, we were the proud winner of the National Quality Award.

The Distinguishing Features of Shuang-Ho Hospital

Shuang-Ho Hospital not only has built up a perfect "Acute Severe Care" system with the unique "Medical Use hospital helipad" which offers 24-hour standby Air-EMS to patients and allocates scarce medical resources for off-shore islands, but also has a passionate ER medical team to provide 24 hours a day, 365 days a year, health care service. With fully and well equipped operation rooms plus strong and professional physical and surgical teams from famous medical centers, Shuang-Ho Hospital has extraordinary capability and good reputation on Neural Medical Center, Minimally Invasive Surgery Center, Ophthalmology and Visual Science Center, Cardiovascular Center, Rehabilitation Center, , Multipolar Radiofrequency Ablation Center and Trauma Center. Moreover, Shuang-Ho Hospital has outstanding achievements on the following aspects.

1. The Dialysis Center has a national-leading control measure to isolate the beds, equipment, and areas in order to prevent from hepatitis C infection.
2. The first "Dental Care Center for Persons with Special Needs" in the country to provide dental care service to about 130,000 physically and mentally handicapped people in New Taipei City.
3. The Cancer Center led by the world well-known Dr. Jacqueline Whang-Peng (member of Academia Sinica) offer the best radiation therapies and comprehensive cares with the most advanced facilities in the world in order to provide the best and most comfortable medical care environment.
4. The Health Management Center in the 12F has professional service team and comfortable environment in order to provide comprehensive personal health management.




In addition to providing quality health care services, our hospital is also committed to research and teaching. We founded the Translational Medicine research lab for innovative research and the Brain and Consciousness research Center for Integrate cognitive neuroscience. We also built the Clinical Skill Center to help our medical staff cultivate professional competence, attitude and skills in their clinical practice, and provide our patients with complete care.

Perspectives of Shuang-Ho Hospital

The visions of Shuang-Ho Hospital are to provide the best health service and medical care to the community, and to be the top center for medical education, research, and service. Moreover, to expand the medical service in Taiwan, we devote to cooperate with medical institutions all over the world. Finally, with the full supports from Taipei Medical University, the commitment of top management, and all employees' engagement, the long-term mission to become one of the top university hospitals in the world with the best medical quality and performance will come true in future.

TMU HEALTHCARE SYSTEM

HSIN KUO MIN HOSPITAL

About

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Founded in 2019

TAIPEI MEDICAL UNIVERSITY - HSIN KUO MIN HOSPITAL

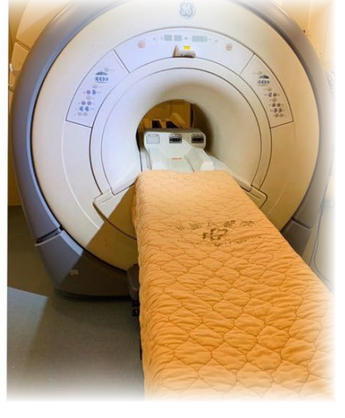
Taipei Medical University - Hsin Kuo Min Hospital is located near Zhongli Station of Taoyuan City.

Hsin Kuo Min Hospital is the fourth affiliated hospital of Taipei Medical University, which is aiming to become one of the world's top medical schools. In the past half century, thousands of outstanding medical professions have graduated from Taipei Medical University and made great contributions for Taiwan with dedications.

Hsin Kuo Min Hospital has a strong and professional medical team of high quality. Orthopedic surgeons specialize in prevention, diagnosis and treatment of bones, joints, ligaments, tendons, muscles and nerves disorders. Physicians in the department have expertise in all areas of orthopedics, including minimally invasive surgery, spine disorders, joint reconstruction and revision, foot and ankle injuries, hand surgery, and trauma. The Department of Rehabilitation Medicine provides physical therapy, occupational therapy, and other services. We provide rehabilitation services for patients with various musculoskeletal disorders, injuries, or diseases.

Hsin Kuo Min Hospital continually upgrades and improves the quality of medical management system, and provides the best quality and service to the people and local community.



TMU TAIPEI NEUROSCIENCE INSTITUTE

About

Taipei Neuroscience Institute (TNI) was established in 2017 after the integration of all the departments of neurosurgery, neurology, neuroradiology, rehabilitation and psychiatry of the university's three affiliated general hospitals in Taipei. We hope that through this integration we can promote our standard of practice in clinical neuroscience, improve our quality of clinical training and education, and enhance our research collaboration between clinicians and basic neuroscientists.

Twelve Departments

Built upon its solid foundation, the TMU-TNI has twelve departments, including Neuro-oncology, Radiosurgery, Cerebrovascular Disease, Neurorehabilitation, Degenerative Disease, Neuropsychology and Cognitive Function, Spinal and Peripheral Nervous Disorder, Pain Disorder, Pediatric Neurology, Neurotramatology and Intensive Care, Vertigo, Sleep Disorders, and Headache, and Epilepsy. Inter-disciplinary discussion is emphasized and held to offer patients the best medical service.

Research and Education

In terms of integrating and research, the TMU-TNI collaborates closely with the TMU. Clinicians and scientist work on research projects together and carry out trials with other universities or research institutes in Taiwan and abroad. We promote the collaboration between the university and the medical industry and encourage our teams to host neuroscience seminars and large conferences. Furthermore, we established a neuroscience research institute in TMU and provide training courses for new students, putting in as much effort as possible into nurturing clinical and research talents.

Vision

future with a desire to further improve neuroscience both locally as well as around the world. Not only do we aim to become a vanguard medical center recognized worldwide, we are also devoted to providing the highest level health care to the people of Taiwan and its surrounding countries.

TMU TAIPEI CANCER CENTER

Established in 2013, Taipei Cancer Center at Taipei Medical University is Taiwan's first cancer center providing comprehensive cancer services including cancer prevention, screening, diagnosis, treatment, long-term follow-up, and consultation.

Our multidisciplinary care team, led by expert cancer physicians includes nurses, pharmacists, nutritionists, social workers, psychologists, and other medical professionals, provides personalized care and treatment plans. With the assistance of the Artificial Intelligence systems, Watson for Oncology and Watson for Genomics, the clinicians develop individualized cancer treatments with precision medicine for their patients.

Through the expertise of the internationally recognized Taipei Medical University Translation Research Center, we combine newly developed treatment plans and current therapies to maximize patient outcomes. In addition, the Taipei Cancer Center provides new and effective therapies for difficult-to-treat and late-stage cancer patients.

At Taipei Cancer Center, our goal is to maintain high quality of life for patients and improve survival rate matching the international standard. We expect to provide our patients with the most effective, safest and high quality integration through teamwork within the hospital system of Taipei Medical University. Our vision is to provide excellent quality tumor care consistent with international standard from prevention to diagnosis to treatment. Our core value is rooted in international level of excellence, totally integrated care, high quality of life and improved cure rate.

To offer the cancer treatment and service matching the international standard and quality, Taipei Cancer Center launched the "Taipei International Medical Cancer Special Outpatient Service" program in April 2014 to provide cancer patients with high quality integrated medical services throughout the process including consulting, diagnosis, treatment, care, follow-up and prevention.

The Proton Center, to be completed in 2020, will provide fourth generation proton therapy with pencil-beam technology and cone-bean CT navigation. This new radiotherapy technology will greatly enhance the quality of medical care and outcomes for our patients with cancer.

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The features of the medical services from Taipei Cancer Center include:

World-class Services:

Prestigious local and international specialists above the level of associate professor with various specialties in cancer treatment work as consulting physicians at the center. An optimized treatment suggestion will be provided to individual patients after a comprehensive evaluation.

Personalized Services:

A medical team with consulting physicians as core members will create a customized overall treatment plan for individual patients. Our Navigator will design the navigation services to bring the best possible treatment outcome to the patient.

Integrated Services:

Our team of caregivers including dieticians, pharmacists, psychiatrists and social workers will work under the instructions of the medical consulting team to provide personalized integrated care.

Tradition & Innovation:

Combining both traditional and innovative methods of treatment, we have worked with Taipei Medical University — The Center of Translational Medicine on various clinical trials to provide the most advanced treatment method targeting at the types of cancers involving a great level of treatment difficulty or terminal cancer patients.

TMU CAMPUS LIFE

Sports Facilities

Student Clubs

Library

Food Court and Restaurants

Transportation

TMU CAMPUS LIFE

About

The university facilities include a library which contains 150,000 volumes, a swimming pool, a food court with an Italian restaurant, a convenient store, a dormitory (four students in one air-conditioned room with beds and desks for each student, restrooms, balconies, etc.), a computer lab, meeting rooms, and offices for nearly 80 student club. TMU is within walking distance to the biggest shopping area in Taipei. In ten minutes, one could arrive at Taipei 101, Cinema with six department stores and one 24hour book store.

Sports Facilities

TMU Gymnasium provides a complete range of facilities for indoor sports, such as standard-size swimming pool, whirlpool, sauna, aerobics room, cycling room, weight training room, table tennis and badminton areas. Outdoor sports courts for baseball, softball, basketball, tennis and golf are also available on campus.

Student Clubs

Student clubs are abundant at Taipei Medical University! Eighty-five clubs offer opportunities in service, entertainment, academics, performance and management. TMU leads Taiwan's universities in student activities, which are important parst of the TMU experience, especially medical service activities. Normally nine groups serve in remote villages or foreign countries each winter vacation, while in summer a dozen groups offer help in underserved areas. Students participating in these groups are not only offered free medical services and health care education, but also perform live shows to entertain their host communities. South India and Malawi were the destinations of recent trips.

Library

Taipei Medical University's main library was established in 1962. The collections include printed and electronic books, journals and databases in Chinese, English, Japanese and other languages. The library receives more than 10 newspapers and 230 magazines every day and all the databases can be accessed online. In addition to circulation services, the library provides other services such as library orientation and instruction, reference service, inter-library loan and selective dissemination of information.

Food Court and Restaurants

Inexpensive and nutritious meals are easy to find on campus. The food court in the lower level of the United Medical Building offers sandwiches, hamburgers, Chinese lunch boxes, fresh fruit drinks, noodles, and vegetarian food. The upper level is Mr. J, an Italian-French restaurant sponsored by popular singer and composer Jay Chou and friends. A convenience store next door offers other meal options.

Trasportation

TMU Shuttle Bus

Roads & Streets

A. 220 Lane, WuXing Stree
B. Wusing Street(WuXing Street
C. 284 Lane,WuXing Street
D. 22 Alley, 284 Lane.WuXing Stree

Entrances

i. University Entrance
ii. Hospital Entrance
iii. Ambulance Entrance

▲ TMU hospital shuttle bus stop is at " **ii. Hospital Entrance** ".

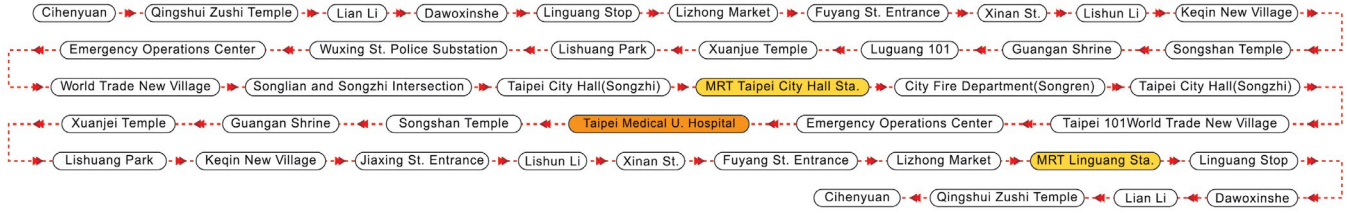
Bus

This is the list of bus lines you may find at the bus stop that serves Taipei Medical University on Zhuang Jing Rd.

- **BUS 1, 22, 33, 37, 226, 266, 266 區 , 288, 288 區 , 藍 5**

- **Citizen MiniBus M7**

  Is the only bus that gets closer to TMU, and its terminal station is MRT City Hall Station.



Ubike

Ubike is a new lifestyle in Taipei. Rent bikes using your transit "EasyCard"and return them wherever you want to go. TMU's rental station with available Ubikes looks like this.

The map shows Ubike rental & retun places near TMU. Check if your destination provides Ubike renting and parking services at http://taipei.youbike.com.tw/en/f11.php