In this study, we employed a novel one step electrospinning process to fabricate poly(ethylene oxide) (PEO)/poly(3,4-ethylenedioxythiophene): polystyrenesulfonate (PEDOT:PSS) core/shell nanofiber structures with improved water resistance and good electrochemical properties. We then integrated a biocompatible polymer coating with three-dimensional (3D) PEDOT-based nanofiber devices for dynamic control over the capture/release performance of rare circulating tumor cells (CTCs), as well as the label-free detection by using organic electrochemical transistors (OECTs). The detailed capture/release behavior of the circulating tumor cells was studied using an organic bioelectronic platform comprising PEO/PEDOT:PSS nanofiber mats with 3 wt % (3-glycidyloxypropyl)trimethoxysilane as an additive. We have demonstrated that these nanofiber mats deposited on five-patterned indium tin oxide finger electrodes are excellent candidates for use as functional bioelectronic interfaces for the isolation, detection, sequential collection, and enrichment of rare CTCs through electrical activation of each single electrode. This combination behaved as an ideal model system displaying a high cell-capture yield for antibody-positive cells while resisting the adhesion of antibody-negative cells. Taking advantage of the electrochemical doping/dedoping characteristics of PEDOT:PSS materials, the captured rare cells could be electrically triggered release through the desorption phenomena of PLL-g-PEG-biotin on device surface. More than 90% of the targeted cancer cells were captured on the 3D PEDOT-based nanofiber microfluidic device; over 87% of captured cancer cells were subsequently released for collection; approximately 80% of spiked cancer cells could be collected in a 96-well plate. For the OECT design, it was demonstrated for monitoring CTC-capture performance and identifying cancer cell phenotypes. This 3D PEDOT-based bioelectronic device approach appears to be an economical route for the large-scale preparation and detection of systems for enhancing the downstream characterization of rare CTCs.

Biography:
Peilin Chen received his Bachelor degree in Chemistry from National Taiwan University in 1990 and obtained his Ph.D. degree in Chemistry from University of California, Irvine in 1998. He worked as a postdoctoral fellow in the Chemistry department of University of California, Berkeley between 1999 and 2001. Prof. Chen joined Research Center for Applied Sciences, Academia Sinica, Taiwan as an Assistant Research Fellow in 2001. He was promoted to Associate Research Fellow and Research Fellow in 2005 and 2010, respectively. He served as the deputy director of the Research Center for Applied Sciences between 2010 and 2012 and the Chief Executive Officer of the thematic center of Optoelectronic in 2012. Prof. Chen was a visiting Professor in RIKEN and Kyoto University. Prof. Chen received several prestigious awards in Taiwan including Research Award for Junior Research Investigators in Academia Sinica, Ta-You Wu Memorial Award of National Research Council and Career Development Award in Academia Sinica. Prof. Chen has authored or co-authored more than 130 papers in refereed journals and conference proceedings, he has delivered more than 70 invited talks in international meetings and conferences. He organized more than 10 international symposia.
In this talk, I will discuss our recent attempt to develop a new type of radiation therapy that combines synchrotron-generated monochromatic X-ray with mesoporous silica nanoparticles (MSNs). In this approach, we deliver high Z elements such as gadolinium, gold or silver to the tumor by the use of nanoparticles that result in distributing the element throughout tumor mass (tumor spheroid). Then the spheroid is irradiated with monochromatic X-ray generated at SPring-8, a synchrotron in Harima, Japan. When we used monochromatic X-ray harboring an energy level that corresponds to the K-edge energy of the element, we observed dramatic destruction of the tumor spheroid. Our analysis suggests that the effect is due to the Auger effect releasing electrons that will damage DNA and cause cell death. Our approach will provide a solution to the problem with current radiation therapy regarding adverse effect on normal tissues. In addition, effect of X-ray at the tumor can be amplified by the absorbance of the X-ray energy with high Z elements. This work was carried out in collaboration with Drs. Saitoh and Shiro at SPring-8 (QST).

Biography:

Fuyuhiko Tamanoi received his PhD in Molecular Biology from Nagoya University in 1977. After completing postdoctoral training at Harvard University, he worked at Cold Spring Harbor Laboratory as a staff scientist (1980-1985). He was appointed as an Assistant Professor at the University of Chicago. He was appointed as an Associate Professor at University of California, Los Angeles and promoted to Professor in 1997. In 2017, he received an appointment at Kyoto University. He has recently established Quantum Nano Medicine Center at Kyoto University. He has worked on various aspects of Cancer research that include signal transduction, anticancer drugs and nanoparticle-based therapy.
Overcoming the immunosuppressive tumor microenvironment is critical to realizing the potential of cancer immunotherapy strategies. Recent evidences are emerging to show that the cyclic di-guanylate (c-di-GMP), a molecular adjuvant, could induce the production of type I interferons (IFNs) via the stimulator of interferon genes (STING) dependent pathway in antigen presenting cells (APC), leading to enhance the tumor immunogenicity. However, the efficacy of negatively charged c-di-GMP may be limited by some inherent shortcomings, including the poorly membrane permeable, rapid clearance and the inefficiency of cytosolic delivery. Hence, we attempt to develop an alternative “in situ vaccination” approach based on nanotechnology to initiate an antitumor immune response.

In this study, PEGylated RITC fluorescent mesoporous silica nanoparticles (MSN) with a positively charged molecule (N-trimethoxysilylpropyl-N,N,N-trimethylammonium chloride, TA) by co-condensation was synthesized to form RMSN-PEG/TA. The characteristics of nanoparticles were determined by transmission electron microscopy (TEM), dynamic light scattering (DLS) and nitrogen adsorption-desorption isotherm. The anionic c-di-GMP was loaded into cationic RMSN-PEG/TA via electrostatic interactions (c-di-GMP@RMSN-PEG/TA), showing the loading amount of c-di-GMP on c-di-GMP@ RMSN-PEG/TA was around 3 wt%. RAW264.7 cells treated with c-di-GMP@RMSN-PEG/TA obvious increased the production of IL-6, IL-1β, and IFN-β analyzed by real-time PCR, as well as the expression level of phospho-STING (Ser365) protein investigated by western blot. The mouse 4T1 breast tumor-bearing Balb/c mice received injection of c-di-GMP@RMSN-PEG/TA revealed dramatically tumor growth inhibition accompanied by the infiltration of activated CD11c+ dendritic cells and CD4+ T cells at the tumor site detected by flow cytometry. We validate this in situ vaccination by STING pathway activation provides an attractive therapeutics for breast cancer, highlighting its potential to improve clinical outcomes of cancer immunotherapy.

Biography:

Dr. Yi-Ping Chen received his PhD in Chemical Biology from National Taiwan University in 2013 and worked as a postdoctoral fellow at Research Center for Applied Sciences, Academia Sinica, Taiwan (2013–2015). Then, he joined Taipei Medical University as an assistant professor in 2015 and had been a visiting scientist at UCLA in 2016. His current research interests focus on the design and synthesis of multifunctional mesoporous silica nanoparticle (MSN) for biomedical applications, including protein delivery approach, antibody targeting and cancer therapy. Besides, Dr. Yi-Ping Chen and his collaborators aim to design an ideal MSN with the characteristics of biocompatibility, stability, and not accumulate in organs after administration in order to push the nano carrier into preclinical, as well as attempt to address the current developmental and therapeutic challenges.
Medical applications of multifunctional nanoparticles are expected to be one of the most important possibilities in innovative medicine. Organosilica nanoparticles are novel nanomaterials that are prepared from a single organosilicate coupling agent (organotrialkoxysilane) such as 3-mercaptopropyltrimethoxysilane. Organosilica nanoparticles are both structurally and functionally different from typical silica nanoparticles (inorganosilica nanoparticles) prepared from tetraalkoxysilane. The organosilica nanoparticles contain both interior and exterior functionalities such as mercaptopropyl residue as prepared. The organosilica nanoparticles allow for facile surface and internal functionalization, offering new opportunities to create multifunctionalized nanoparticles. Over the last two decades, research on the internal functionalization of organosilica nanoparticles has evolved. Various sizes of fluorescent organosilica nanoparticle containing various types of fluorescent dye including near infrared (NIR) dye can be prepared using a one-pot synthesis. In addition, functional fusions of organosilica nanoparticles and other functional nanoparticles such as quantum dots, gold nanoparticles, and iron oxides are possible based on organosilica particles technology. These multifunctionalized organosilica nanoparticles are useful for various imaging techniques such as in vivo imaging, cell labeling, time-lapse fluorescent imaging, and multimodal imaging. Multifunctionalized organosilica nanoparticles have high potential to create novel imaging systems and provide novel information of cell characteristics and functions. In recent year, we have launched additional research on surface functionalization of organosilica nanoparticles using biomolecules and polymers. Surface-functionalized organosilica nanoparticles revealed various alterations of the interaction with cells including tumor cells and macrophages. We applied multifunctionalized NIR organosilica nanoparticles to tumor-bearing mouse. The particles showed an accumulation on tumor tissue on NIR in vivo imaging, and damaged tumor cells by using photodynamic effect. Imaging and therapy using multifunctionalized organosilica nanoparticles allow for nano-theranotics.

Biography:

Michihiro Nakamura is a Professor and Chairman of Department of Organ Anatomy and Nanomedicine in Yamaguchi University Graduate School of Medicine since 2016. Recently he is the leader of International Nano-Theranostic Center (iNTC) for center formation project of Yamaguchi University. He was awarded his M.D. degree from the Tokushima University School of Medicine, and obtained medical license in 1992. He studied enzymology and protein engineering, and was awarded his Ph.D. degree in 1997 from the Graduate School of Medicine at Tokushima University. After 3 years of clinical training as a clinical resident in rheumatology and hematology at Kyushu University, he joined the medicine faculty of the Tokushima University as an assistant professor in 1999. From 2002 to 2004 he studied immunotoxin and molecular interaction as a visiting fellow in Laboratory of Molecular Biology, National Cancer Institute, NIH in USA. His research interests include the creation and applications of multifunctional nanoparticles in biomedical research since 1999. He has developed a novel type of silica nanoparticles, organosilica nanoparticles made from a single organosilicate. He demonstrated that multifunctional nanoparticles provide novel imaging approaches such as single cell imaging and multimodal imaging providing seamless and sequential findings of tumor tissue from macro to micro. His current research activities include multifunctional nanoparticles enable to create novel imaging system and therapeutic applications toward cancer theranotics.
Activatable theranostic agents for targeted near-infrared fluorescence imaging and photodynamic therapy

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My laboratory has been developing various types of activatable and dual-targeted photosensitizing agents as smart theranostics for selective near-infrared fluorescence imaging and photodynamic therapy (PDT) of cancers and inflammatory diseases. Recently a fucoidan-based theranostic nanogel (CFN-gel) consisting of a fucoidan backbone, redox-responsive cleavable linker, and photosensitizer was developed to achieve activatable near-infrared fluorescence imaging of tumor sites and an enhanced PDT to induce the complete death of cancer cells. A CFN-gel has nanomolar affinity for P-selectin and VEGF. Moreover, a CFN-gel is non-fluorescent and non-phototoxic upon its systemic administration due to the aggregation induced self-quenching in its fluorescence and singlet oxygen generation. After internalization into cancer cells and tumor neovascular endothelial cells, its photoactivity is recovered in response to the intracellular redox potential, thereby enabling selective near-infrared fluorescence imaging and an enhanced PDT of tumors. It also provides a significant antitumor effect in the absence of light treatment in vivo. Our study indicates that a fucoidan-based theranostic nanogel is a new theranostic material for imaging and treating cancer with high efficacy and specificity.

Biography:

Dr. Yongdoo Choi received his Bachelor degree in Polymer Engineering from Chonnam National University in 1996 and obtained his Ph.D. degree in Material Science from Gwangju Institute of Science and Technology, Korea in 2003. He worked as a postdoctoral fellow in the Radiology department of Massachusetts General Hospital, Boston between 2003 and 2006. He joined National Cancer Center (NCC), Korea as a Senior Research Scientist in 2007. He is now a principal research scientist and chief of Nanochemistry Laboratory at NCC Korea. He is serving as a deputy editor of Quantitative Imaging in Medicine and surgery, Associate editor of Frontiers in Bioengineering and Biotechnology, Frontiers in Materials, Frontiers in Molecular Biosciences, Editorial Advisory Board of Bioconjugate Chemistry, etc. His laboratory focuses on the development of novel molecular imaging agents for image-guided surgery, activatable photodynamic therapy agents, and theranostic nanomedicines.
Nerve-cell culture takes an irreplaceable role in molecular and cellular neuroscience. However, its use in studies at the systems level has been limited due to the substantial difference between in vivo in vitro network dynamics. The dynamics is affected by the difference in the intercellular connectivity (Yamamoto et al., Sci. Adv. 4, eaau4914 (2018)), as well as by the excessively strong excitatory synapses in cultured neurons. Recently, a study was reported that stiff scaffolds enhance the strengths of excitatory synapses in cultured hippocampal neurons (Zhang et al., Sci. Rep. 4, 6215 (2014)). As neuronal cultures are generally performed on polystyrene or glass, which is approximately 10^6 to 10^7 times stiffer than the brain tissue, we hypothesized that the in vitro artifact in excitatory synaptic strength can be reduced by using a scaffold that mimics the elasticity of the brain tissue. Here we employed an ultrasoft silicone elastomer, whose elastic modulus resembles that of the brain tissue (~0.5 kPa), as a scaffold for culturing rat cortical neurons. We investigated the effect of the biomimetic elasticity on the strength of excitatory synapses and the spontaneous network activity (Sumi et al., arXiv 1912.05050 (2019)). We found that the amplitude of excitatory postsynaptic currents was smaller on softer scaffolds. Although globally synchronized bursting activity in cortical cultures were still observed when the cells were grown on the ultrasoft substrate, neuronal correlation was significantly reduced as compared to the cultures on stiffer (>14 kPa) substrates. In the latter half of the talk, we will show how the multielectrode array devices with the ultrasoft cell-device interface can be fabricated by taking advantage of additive manufacturing technologies, such as inkjet printing (Yamamoto et al., Adv. Biosys. 3, 1900130 (2019)). Our device employs 3D micropillar electrodes, which can be fabricated relatively easily by inkjet printing. Such devices facilitate the stimulation and recording of cultured neuronal networks grown on biomimetic scaffolds, for both basic research and pharmacological studies.

Biography:

Hideaki Yamamoto received his bachelor’s degree in Electrical Engineering from Waseda University in 2005 and obtained his PhD in 2009 from the same university. He then conducted postdoctoral research at Waseda University and at Tokyo University of Agriculture and Technology, before joining Tohoku University in 2014. He is currently an Associate Professor and a JST-PRESTO Researcher at Research Institute of Electrical Communications. He is interested in how a complex network of excitable cells realize robust computation in the brain. To this end, he develops microfabrication and surface modification technologies to engineer the structure and function of cultured neuronal networks in culture. He is currently a member of the Japan Society of Applied Physics, the Japan Society of Vacuum and Surface Science, and the Japan Nanomedicine Society.
Naturally derived biomaterials for 3D stem cells loaded bio-ink

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The native tissues are complex structures consisting of different cell types, extracellular matrix materials, and biomolecules. Traditional tissue engineering strategies have not been able to fully reproduce biomimetic and heterogeneous tissue constructs because of the lack of appropriate biomaterials and technologies. However, recently developed three-dimensional bioprinting techniques can be leveraged to produce biomimetic and complex tissue structures. To achieve this, multicomponent bioinks composed of multiple biomaterials (natural, synthetic, or hybrid biomaterials), different types of cells, and soluble factors have been developed. In addition, advanced bioprinting technologies have enabled us to print multimaterial bioinks with spatial and microscale resolution in a rapid and continuous manner, aiming to reproduce the complex architecture of the native tissues. In this study, we developed a new formulation of bio-ink which is based on methacrylated keratin and methacrylated glycol chitosan. The feasibility of this bioink was tested with human adipose-derived stem cell toward specific differentiation conditions.

Biography:

Dr. Yu received her B.S. in Chemical Engineering in 2003 from National Taiwan University, Taiwan, R.O.C and Ph.D. in 2008 from UC Berkeley/UC San Francisco Joint Graduate Group in Bioengineering. Dr. Yu worked as a postdoctoral researcher at UCSF Medical School and Cardiovascular Research Institute from 2008-2010. She relocated back to her alma mater in 2010 and was an Assistant Professor from 2010-2015 and Associate Professor from 2015-2019. Dr Yu is promoted to full Professor from Aug. 2019  
Dr. Yu’s group focus on customized and functional modification of biomaterials including surface modification of biomaterials to enhance cell and extracellular matrix (ECM) interaction. Antibody and peptides conjugated nanoparticles as biosensors and drug delivery vehicles for cancer therapy, cell encapsulation and 3D culture of hASCs (human adipose-derived stem cell) in alginate-based microspheres and various porous scaffold and hydrogel for stem cells differentiation. The group has representative publications in Biomaterials, Tissue Engineering, ACS Applied Materials and Interfaces, Journal of Materials Chemistry B and Biomaterials Sciences etc.

Dr. Yu is the editorial board members of Physics and Chemistry of Stem Cells (Walter de Gruyter, German) and Am J Tissue Eng & Stem Cell (Columbia International Publishing, USA). She is the Associate Editor of Acta Cardiologica Sinica.)
Cell adhesion is a requisite stage in a number of physiological and pathological processes, such as cell differentiation, immune responses, and tumor metastasis. The process of cell adhesion is composed of three steps, cell-substrate contact, cell spreading, and cytoskeleton reorganization. Conventional adhesion assays, such as colorimetric and fluorometric detection, are time-consuming and insensitive. Tracking of cell morphological changes is often difficult to quantify. In the past decades, surface plasmon resonance (SPR) is widely applied in biosensing technology due to the rapid, real-time and label-free characteristics. Here, we developed a novel metal nanoslit-based biosensor with a detection platform of transmissive surface plasmon resonance (t-SPR). The platform can determine cell adhesion by Fano resonance signals, which are changed during cell binding to the nanoslit. Therefore, we can simultaneously analyze the focal adhesion and cell spreading through the spectral peak and dip of the Fano resonance. The peaks and dips reflect the long- and short-range cellular changes, respectively. We previously examined the features of cell adhesion and found that this method has great potential for estimating the thickness of adherent cells and the metastatic potencies of lung cancer cells. Metastasis, a complicated process in which cancer cells spread from a primary tumor to distant sites via the circulatory system, is the main cause of death in cancer patients. In light of this fact, we are now screening commercial drugs like ion-channel inhibitors and G protein-coupled receptors (GPCR) compounds which are related to cell adhesion and might involve in metastasis. The screening could reveal candidates which may be used as anti-metastasis drugs.

**Biography:**

Dr. Ji-Yen Cheng received his B.Sc., M.Sc., and Ph.D. degree from Chemistry Department of National Taiwan University. After graduation in 1998, he then started his post-doc research on the DNA microarray in the Institute of Biomedical Sciences in Academia Sinica Taiwan. In 2001 he joined Research Center for Applied Sciences in Academia Sinica as an assistant researcher fellow. He was promoted to associate research fellow and research fellow in 2007 and 2013, respectively. Since 2015, he served as the Chief Executive Officer of the Thematic Center for Mechanics and Engineering Sciences. His research interest is in the biological applications of microfluidics. Some specific topics include the following:

- Cell-based micro analysis, especially cell response in weak DC EF, cell-cell interaction co-culture chip, cellular chemotaxis, electrotaxis and metastasis, affinity binding, and separation.
- Rapid prototyping of microfluidic biochip using laser micromachining.
- Microarray technologies such as flexible in-situ array synthesis, rapid hybridization, mRNA labeling chip, and portable DNA amplification chip.
- Laser micromachining – mechanism and applications.

Dr. Cheng has published more than 120 journal articles and conference proceedings, and 6 patents. His works in rapid prototyping and DNA amplification chip have been reported in Lab-on-chip.
Molecular environments inside cells are surprisingly crowded with numerous number of biomolecules. About 40 percent of the cell volume is occupied by biomolecules. Biochemical reactions are subject to be temporally, spatially, and specifically controlled. From biochemical and biophysical point of views, it is incredible that selective interactions and specific functionalization of biomolecules in the temporal and spatial-specific manner can be achieved under the complex molecular crowding environments.

One of the key futures to achieve the specific interaction of biomolecules is collective biomolecular behavior. In recent years, biomolecular localization and compartmentation systems using droplets via liquid-liquid phase separation (LLPS) inside cells, become one of the most hot research topics in biology. Droplets are temporarily formed, and their formation is reversible and responsive to various external signals, which are in contrast with aggregation of biomolecules which is generally irreversible.

In this presentation, we will show a model system of a droplet in a test tube, in which we use nucleic acids (RNA and DNA) which forms G-quadruplexes and arginine-rich peptides which do not have any stable structure. By mixing these two components, a rapid LLPS was observed. It was suggested that the G-quadruplex structure is critical for undergoing LLPS. In the talk, we would like to discuss property of the droplet as a biomaterial.

Biography:

Daisuke Miyoshi received his Bachelor degree in Chemistry from Konan University, Japan in 1995 and obtained his Ph.D. degree in Science from the same University in 2003. He worked as a postdoctoral fellow in the chemistry department of University of Illinois at Urbana-Champaign between 2003 and 2004. He joined Frontier Institute for Biomolecular Engineering Research (FIBER), Konan University, Japan as an Assistant Professor in 2004. He was promoted to an Associate Professor and a Professor in 2009 and 2014, respectively in the current department. His research interests include non-canonical nucleic acid structures (G-quadruplex, I-motif, triplex, junction, hairpin loop, etc.), small molecules targeting nucleic acids and their applications especially molecularly-targeted photodynamic therapy, molecular crowding, and liquid-liquid phase separation. He has authored or co-authored more than 130 papers, reviews, and book chapters, and delivered more than 50 invited talks in international and domestic meetings and conferences.
Optical Engineering of Natural Materials for Daytime Radiative Cooling

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Nowadays, problems of energy crises and climate change pose a threat to human living. Therefore, developing eco-friendly cooling systems is an utmost issue to work on. Most of current cooling methods require energy to carry heat away. By means of passive radiative cooling, the system can radiate heat to outer space through the atmospheric transmission window between 8-13 μm, thus lowering the temperature without any energy consumption. Some photonic solar reflector and thermal emitter, like HfO₂, SiO₂ and metamaterial film, can reflect incident sunlight while emitting radiation in the atmosphere windows. However, with its complicated fabrication and high cost, nanophotonic approach is hard to scale up to meet the requirements of commercial applications. Meanwhile, we focus on natural materials of great potential which are still not well-studied.

Compared to the typically narrow Infrared (IR) emissivity peaks of artificial daytime cooling materials, the extremely broadband emissivity peak of the natural materials could cover two atmospheric windows (8-13 μm and 16-25 μm). Here, we present a study on silk cocoon, which is characterized by its 90% absorption at IR wavelengths and simple, well-studied fabrication process for different morphologies. We fabricated silk fibroin thin film with thickness ranging from 6 to 88 μm by adjusting the concentration of silk fibroin solution. We observed the broadening of thickness leads to an increase in emissivity over IR wavelength regions, indicating thickness is the key factor to optical and radiative control. In addition to simulated spectra, the optical constants of silk film are calculated for further analysis. We also investigated the broadband absorption and extinction coefficients at NIR wavelength. Throughout the MIR wavelengths (4-25 μm), silk films exhibit a maximum absorbance of 92% at the thickness of 100 μm. However, the absorbance of silk film has positive correlation with thickness in solar spectrum region, resulting in high $P_{sun}$ performance. Therefore, thermal simulation is applied to find the lowest $T_{eq}$, at which the optimal thickness of silk film is located. Finally, we conducted temperature measurements on the optimal silk films practically to verify its daytime radiation cooling ability. With silk covering, the surface temperature of a smartphone decrease by 3.5 K, while the average absorbance of mobile phone is significantly enhanced to 94 % in atmospheric window.

Biography:

Dr. Dehui Wan received his B.S. (2003) in Chemistry and Ph.D. (2010) in Material Science and Engineering at the National Taiwan University. He completed his doctoral thesis under the supervision of Dr. Hsuen-Li Chen and developed various novel nanoparticle-based optical systems for light-harvesting devices and optical data storage. He later worked with Dr. Younan Xia as a postdoctoral research fellow of Department of Biomedical Engineering, Georgia Institute of Technology. He joined the faculty of National Tsing Hua University as a tenure-track Assistant Professor in 2013 and was promoted to Associate Professor in 2017. His work integrates shape-controlled synthesis, surface chemistry and optical engineering of nanostructures to develop novel bio/chemical sensors, energy efficient devices, and photothermal cancer therapy. Dr. Wan has published 27 journal papers with nearly 1300 citations and an h-index of 15, and he also published 6 international patents. He received National Tsing Hua University Young Investigator Award (2016) and Dr. Zhao-ren Li Biomedical Engineering Young Investigator Award (2016).
Mesoporous silica nanoparticles (MSNs) is a promising nanocarrier for delivering anti-tumor drugs to cancer. Polyethylene glycol (PEG) has been linked to many nanocarriers to increase the dispersity, bioavailability and circulation time of nanoparticles. However, on the other hand, PEGylation could limit the cellular uptake and endosomal escape of MSN, resulted in significant loss of activity of the delivery system.

In this study, to overcome the “PEG dilemma”, we synthesized pHR-MSN-PEG/DA@EPIs, in which pH-responsive (pHR) core-shell MSNs were utilized as nanocarriers, the anti-tumor drug epirubicin (EPI) was encapsulated by electrostatic interaction, and the amine-containing (DA) functional groups were introduced to control the loading and release of EPI. In vitro studies showed that the plain pHR-MSN-PEG/DA is non-toxic and the cleavage of PEG from carriers was achieved in response to acidic environment, result in high efficiency of cellular uptake. In addition, pHR-MSN-PEG/DA@EPIs showed considerable cytotoxicity towards 4T1 tumor cells. For in vivo studies, pHR-MSN-PEG/DA showed excellent passive targeting behavior due to the enhanced permeability and retention (EPR) effect, and strong tumor inhibition effects in a chicken embryo chorioallantoic membrane (CAM) tumor model.

Biography:

Si-Han Wu received his Master’s and Ph. D. in Chemistry from National Taiwan University in 2008 and 2013, respectively. After a post-doc at Research Center for Applied Sciences of Academia Sinica, he joined Taipei Medical University as an assistant professor. His research interests are in the field of hybrid nanomaterials, focusing on the build-up of mesoporous, hollow and multiple-compartmentalized silica nanomedicine. His current research is aimed to clarify the relationship between synthetic identity and physiological responses, with a focus on (I) developing clinically translatable silica-based nanomedicine to eradicate hypoxic tumor cells, and (II) constructing bacteria-targeting porous silica nanohybrids as antibacterial, antioxidant and anti-inflammatory carriers for sepsis management.
Tensed actin cap fibers are required to stabilize β1 integrin adhesions and
direct cell migration along spatially patterned extracellular matrix

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Our ability to control cell behavior by properly engineered materials and microenvironments is tightly
coupled to understanding the mechanisms of cell-matrix interactions. Anisotropy of extracellular matrix
(ECM) drives cell alignment and directional migration during processes like development and wound
healing, but also in cancer cell migration and invasion. So far, migrational persistence whether on flath
isotropic or anisotropic surface patterns and fibers was mostly studied as local phenomenon asking how
specific integrins are responsible for the recognition of the spatial ECM cues. Yet, cell alignment and
directional migration in response to external ECM cues requires signal integration across length scales. By
producing patterned 2 μm ECM stripes, which lead to cell alignment, and testing the previously described
pan-integrin null fibroblast cells, we indeed observed that cell alignment and directional migration on
patterned stripes were lost when β1 integrin was absent. By combining nanopillar arrays with printed cell-
adhesive fibronectin (FN) stripes, we could probe subcellular force distributions at submicron resolution.
While it was previously recognized that the αv- and β1-class integrin signaling pathways are coupled, via
myosin II contractility, we discover here that myosin III coupling of these integrin signaling pathways
requires a stiff cell nucleus. Importantly, directional migration along adhesive patterned stripes was also
impaired for lamin A/C knockout cells, incapable of forming an actin cap and restored upon lamin A/C
rescue. Together, our data suggest that β1 integrin is required for the recognition of spatial ECM cues and
that force transmission to the nucleus via lamin A/C is essential for subsequent directional migration.

Biography:

Jau-Ye Shiu received his Bachelor degree in Physics from Chinese culture University in 2002 and
obtained his Ph.D. degree in Material Science and engineering from National Chiao Tung University,
Taiwan in 2009. He worked as a postdoctoral fellow in the in the Laboratory of Applied Mechanobiology at
ETH Zurich between 2010 and 2015. Dr. Shiu is a Junior Group Leader / Oberassistent in the Laboratory of
Applied Mechanobiology at the Department of Health Sciences and Technology.