SNU Leaders in Chemistry Colloquium, **Distinguished Scholar On-line Lecture Series** 

# **Functional Molecules** in the Interface between **Chemistry and Biology**

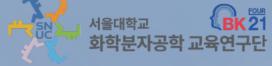
# **Organizers**

**Department of Chemistry** 

Byeong-Hyeok Sohn (Chair, Department of Chemistry) Taek Dong Chung (Head, Molecular Science Research Institute) Yan Lee (Vice Chair, Department of Chemistry)

# **Supporting programs**

SNU 10-10 Project 분자과학연구소 BK21 서울대학교 화학분자공학 교육연구단



### Programs

Lecture 1	Molecular Understanding, Design and Development of Zwitterionic Materials
July 22 <sup>nd</sup> 9am	Prof. Shaoyi Jiang (the Robert S. Langer '70 Family and Friends Professor, Cornell University)

**Intracellular Biologics as Next-Generation Therapeutics** Lecture 2 July 29th 9am **Prof. Dehua Pei** (Charles H. Kimberly Professor, the Ohio State University)

The Supramolecular Chemistry of the Antibiotic Teixobactin: How Basic Research **Lecture 3** August 5<sup>th</sup> 9am on a New Antibiotic Has Provided New Insights and Exciting Opportunities Prof. James Nowick (Department of Chemistry, University of California, Irvine)

# Lecture 1: July 22<sup>nd</sup> 9am - 11am

**Shaoyi Jiang** (the Robert S. Langer '70 Family and Friends Professor) **Cornell University** E-mail: sj19@cornell.edu Web: https://www.engineering.cornell.edu/faculty-directory/shaoyi-jiang



EDUCATION	<ul> <li>1993 Ph.D. in Chemical Engineering, Cornell University, USA</li> <li>1988 M.S. in Chemical Engineering, Nanjing Institute of Chemical Technology, China</li> <li>1985 B.S. in Chemical Engineering, Hua Qiao University, China</li> </ul>			
EXPERIENCE	2020-present	The Robert S. Langer '70 Family and Friends Professor,		
		the Meinig School of Biomedical Engineering, Cornell University		
	1996-2020	The Boeing-Roundhill Professor of Engineering,		
		Department of Chemical Engineering, the University of Washington, Seattle.		
	1994-1996	Research Fellow, California Institute of Technology		
	1993–1994	Post-doctoral Fellow, UC Berkeley		
SELECTED	2018 Assoc	iate Editor, Science Advances, American Association for the Advancement of Science		
AWARDS	2017 Brask	em Award for Excellence in Materials Engineering and Science		

#### Fellow, American Institute of Chemical Engineers 2012 AND Senior Editor, Langmuir, American Chemical Society 2010 **HONORS**

Fellow, American Institute of Medical and Biological Engineering 2010

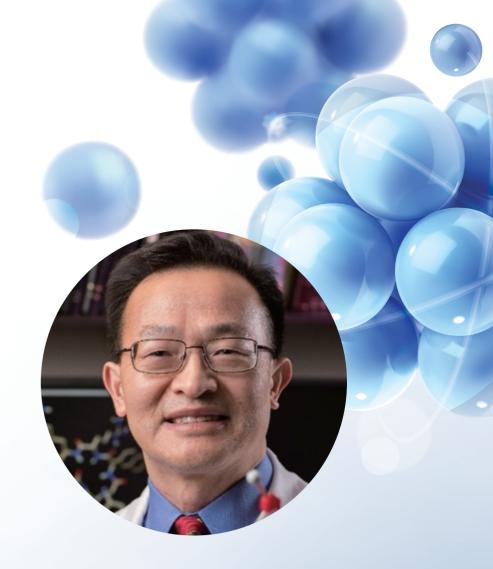
#### **Molecular Understanding, Design and Development of Zwitterionic Materials**

An important challenge in many applications is the prevention of unwanted nonspecific biomolecular and microorganism attachment on surfaces. To address this challenge, our goals are twofold. First, we strive to provide a fundamental understanding of nonfouling mechanisms at the molecular level. Second, we aim to develop biocompatible materials based on the molecular principles learned. As a result, we have shown that zwitterionic materials and surfaces are highly resistant to nonspecific protein adsorption and microorganism attachment from complex media. Typical zwitterionic materials include poly(carboxybetaine), poly(sulfobetaine), and poly(trimethylamine N-oxide). Unlike poly(ethylene glycol) (PEG), there exist diversified zwitterionic molecular structures to accommodate various properties and applications. Furthermore, zwitterionic materials are super-hydrophilic while their PEG counterparts are amphiphilic.

In this talk, I will discuss the application of zwitterionic materials to medical implants, stem cell culture media, medical devices, drug delivery carriers and marine coatings in addition to design principles. With zwitterionic coatings, hydrogels or nanoparticles, results show no capsule formation upon subcutaneous implantation in mice for one year, expansion of hematopoietic stem and progenitor cells (HSPCs) without differentiation, no anti-coagulants needed for artificial lungs in sheep, no antibodies generated against zwitterionic polymers and long-term performance in the marine environment.

# **Lecture 2:** July 29<sup>th</sup> 9am - 11am

Dehua Pei (Charles H. Kimberly Professor) Department of Chemistry and Biochemistry The Ohio State University 484 West 12th Avenue, Columbus, Ohio 43210 E-mail: pei.3@osu.edu Web: https://research.cbc.osu.edu/pei.3/



EDUCATION	1991 Ph.D.	octoral Fellow, Harvard Medical School, USA in Organic Chemistry, University of California, Berkeley, USA Chemistry, Wuhan University, China
EXPERIENCE	2017-Present	Charles H. Kimberly Professor, Department of Chemistry and Biochemistry,
	2011-2016 2004-2011 2001-2004 1995-2001	the Ohio State University Professor, Department of Chemistry and Biochemistry, the Ohio State University Professor, Department of Chemistry, the Ohio State University Associate Professor, Department of Chemistry, the Ohio State University Assistant Professor, Department of Chemistry, the Ohio State University
SELECTED AWARDS AND HONORS	2018 2017 2017-2022 2017-Present 2012-2014 2010 2009	American Chemical Society Columbus Section Award Innovator of the Year, The Ohio State University Maximizing Investigators' Research Award (MIRA), National Institutes of Health Charles H. Kimberly Professorship, The Ohio State University Entrepreneurial Scholar, The Ohio State University Elected Fellow, American Association for the Advancement of Science American Chemical Society Akron Section Award

### **Intracellular Biologics as Next-Generation Therapeutics**

Current drugs (i.e., small molecules and biologics) are effective against only ~20% disease relevant human proteins. Modulation of the remaining ~80% "undruggable" targets requires alternative modalities. Numerous attempts are being made to deliver biologics into mammalian cells, usually by leveraging the endocytic processes. Unfortunately, most of the endocytosed materials remain entrapped inside the endosomal/lysosomal pathway and poor endosomal escape has been a key bottleneck during the development of intracellular biologics. We recently discovered a family of cyclic cell-penetrating peptides (CPPs), which deliver all major drug modalities (e.g., small molecules, peptides, proteins, and nucleic acids) into the cytosol of mammalian cells in vitro and in vivo with unprecedented efficiencies. We have elucidated their mechanism of cellular entry by endocytosis and endosomal escape. We have also applied the cyclic CPPs to develop cell-permeable peptides and proteins as potential treatments of previously intractable diseases caused by intracellular protein-protein interactions (e.g., calcineurin-NFAT, Keap1-Nrf2, CAL-CFTR, and Ras-Raf interactions) or genetic mutations.

# **Lecture 3:** August 5<sup>th</sup> 9am - 11am

James S. Nowick Department of Chemistry University of California, Irvine E-mail: jsnowick@uci.edu Web: http://tinyurl.com/nowickgroup



EDUCATION	<ul> <li>1991 Postdoctoral Fellow, Massachusetts Institute of Technology, USA</li> <li>1990 Ph.D. in Organic Chemistry, Massachusetts Institute of Technology, USA</li> <li>1985 A. B. in Chemistry, Columbia University, USA</li> </ul>		
EXPERIENCE	2019-Present Professor, Department of Pharmaceutical Sciences, University of California, Irvine 2016-2019 Chair, Department of Chemistry, University of California, Irvine 2018-Present Professor, Department of Chemistry, University of California, Irvine 2018-1998 Associate Professor, Department of Chemistry, University of California, Irvine 2019-1996 Assistant Professor, Department of Chemistry, University of California, Irvine		
SELECTED AWARDS AND HONORS	<ul> <li>Charles R. Bennett Service Through Chemistry Award from the ACS Orange County Section</li> <li>American Chemical Society (ACS) Fellow, 2016</li> <li>Open Education Consortium Creative Innovation Award for Open Education Excellence</li> <li>American Association for the Advancement of Science (AAAS) Fellow</li> </ul>		

#### HUNUKS

- 2009 NOGLSTP Scientist of the Year Award, 2009
- 1998 American Chemical Society Arthur C. Cope Scholar, 1998
- 1996 Camille Dreyfus Teacher-Scholar Award

### The Supramolecular Chemistry of the Antibiotic Teixobactin:

#### How Basic Research on a New Antibiotic Has Provided New Insights and Exciting Opportunities

This lecture will describe how my laboratory's efforts to study the recently discovered antibiotic teixobactin lead to a new understanding how this antibiotic achieves its remarkable biological activity. Initial efforts to synthesize teixobactin analogues and perform structure-activity relationship studies lead to the observation that active teixobactin analogues undergo supramolecular self-assembly. X-ray crystallography then provided insights into the supramolecular interactions that impart biological activity. Fluorescence microscopy has allowed us to probe these interactions on the surface of Gram-positive bacteria. Ongoing efforts seek to develop new classes of "supramolecular antibiotics" inspired by what we have learned from teixobactin.

