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

서울대학교 화학분자공학 교육연구단

Programs

Lecture 1
July 22nd 9am

Molecular Understanding, Design and Development of Zwitterionic Materials

Prof. Shaoyi Jiang (the Robert S. Langer '70 Family and Friends Professor, Cornell University)

Lecture 2
July 29th 9am

Intracellular Biologics as Next-Generation Therapeutics

Prof. Dehua Pei (Charles H. Kimberly Professor, the Ohio State University)

Lecture 3
August 5th 9am

The Supramolecular Chemistry of the Antibiotic Teixobactin: How Basic Research on a New Antibiotic Has Provided New Insights and Exciting Opportunities

Prof. James Nowick (Department of Chemistry, University of California, Irvine)

Lecture 1:

July 22nd 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

1993	Ph.D. in Chemical Engineering, Cornell University, USA
1988	M.S. in Chemical Engineering, Nanjing Institute of Chemical Technology, China
1985	B.S. in Chemical Engineering, Hua Qiao University, China

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 AWARDS AND HONORS

2018	Associate Editor, Science Advances, American Association for the Advancement of Science
2017	Braskem Award for Excellence in Materials Engineering and Science
2012	Fellow, American Institute of Chemical Engineers
2010	Senior Editor, Langmuir, American Chemical Society
2010	Fellow, American Institute of Medical and Biological Engineering

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 29th 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

1995	Postdoctoral Fellow, Harvard Medical School, USA
1991	Ph.D. in Organic Chemistry, University of California, Berkeley, USA
1986	B.S. in Chemistry, Wuhan University, China

EXPERIENCE

2017-Present	Charles H. Kimberly Professor, Department of Chemistry and Biochemistry, the Ohio State University
2011-2016	Professor, Department of Chemistry and Biochemistry, the Ohio State University
2004-2011	Professor, Department of Chemistry, the Ohio State University
2001-2004	Associate Professor, Department of Chemistry, the Ohio State University
1995–2001	Assistant Professor, Department of Chemistry, the Ohio State University

SELECTED AWARDS AND HONORS

2018	American Chemical Society Columbus Section Award
2017	Innovator of the Year, The Ohio State University
2017-2022	Maximizing Investigators' Research Award (MIRA), National Institutes of Health
2017-Present	Charles H. Kimberly Professorship, The Ohio State University
2012–2014	Entrepreneurial Scholar, The Ohio State University
2010	Elected Fellow, American Association for the Advancement of Science
2009	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 5th 9am - 11am

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

EDUCATION

1991	Postdoctoral Fellow, Massachusetts Institute of Technology, USA
1990	Ph.D. in Organic Chemistry, Massachusetts Institute of Technology, USA
1985	A. B. in Chemistry, Columbia University, USA

EXPERIENCE

2019-Present	Professor, Department of Pharmaceutical Sciences, University of California, Irvine
2016-2019	Chair, Department of Chemistry, University of California, Irvine
1998-Present	Professor, Department of Chemistry, University of California, Irvine
1996-1998	Associate Professor, Department of Chemistry, University of California, Irvine
1991–1996	Assistant Professor, Department of Chemistry, University of California, Irvine

SELECTED AWARDS AND HONORS

2017	Charles R. Bennett Service Through Chemistry Award from the ACS Orange County Section
2016	American Chemical Society (ACS) Fellow, 2016
2015	Open Education Consortium Creative Innovation Award for Open Education Excellence
2009	American Association for the Advancement of Science (AAAS) Fellow
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.