



CHEMISTRY &
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CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES

Development of biomimetic functional materials using sequence-defined peptoids



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Abstract:

Proteins are essential biopolymers that facilitate a wide range of functions necessary for the survival and propagation of cellular organisms. In nature, proteins play pivotal roles in the assembly of hierarchical biomaterials and exert precise control over biomineral formation. Inspired by these natural processes, numerous sequence-defined synthetic polymers have been developed to mimic the structure and function of proteins for bio-inspired synthesis of functional materials. Among these, peptoids have garnered significant attention due to their biocompatibility and unique properties, combining the advantages of biopolymers and bulk polymers, thereby enabling innovative solutions in materials design and biomimetic engineering.¹⁻⁵

In this presentation, I will discuss our recent progress in the development of peptoid-based nanomaterials^{1-3, 7-15} and their versatile applications.⁷⁻¹⁵ Due to the absence of backbone hydrogen bond donors, peptoids exhibit precise modulation of hydrophobic interactions through the variation of side-chain chemistry. Utilizing these controlled hydrophobic interactions, we have achieved the directed assembly of peptoid sequences into crystalline nanomaterials with well-defined and diverse morphologies. Furthermore, we have demonstrated the ability to integrate a wide range of functional components—including metal-ligand active sites, artificial channels, drug molecules, and nanoparticles—into these crystalline nanomaterials. These advancements have enabled the creation of biomimetic materials tailored for specific applications such as catalytic transformations, drug delivery, antiviral medical countermeasures, biomimetic mineralization, and microelectronics. These findings highlight the versatility and potential of peptoid-based systems in advancing functional material design and addressing critical challenges across multiple disciplines.

References:

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About the Speaker:

Chun-Long Chen is currently a Chief Scientist in the Physical and Computational Sciences Directorate at Pacific Northwest National Laboratory (PNNL), and an Affiliate Professor in the Departments of Chemical Engineering and Chemistry at the University of Washington. He earned his PhD from Sun Yat-Sen University in 2005. Prior to joining PNNL in 2013, he was a Project Scientist at the Molecular Foundry at Lawrence Berkeley National Laboratory. His research focuses on addressing key challenges in the development of sequence-defined peptoids that mimic the structure and function of proteins, enabling the assembly of biomimetic functional materials (e.g. artificial membranes) and facilitating control over inorganic crystal formation. His work is driven by the goal of designing and synthesizing bio-inspired functional materials that match or surpass those found in nature.

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