# Topological and sequence Engineering of Giant Molecules: Structures and Functions

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Abstract:

Inverse design and inverse thinking are critical steps in the new materials developments (materials genome approach). When we design materials with specific functional properties, we often start with independent building blocks which possess well-defined molecular functions and precise chemical structures. Using the “Molecular Lego” approach, we can then, in some cases with multiple steps, assemble such elemental building blocks together in preferred secondary structures (or packing schemes) to construct materials possessing topologically mandated hierarchical structures with desired functions. In this talk, a unique approach along this inverse design and inverse thinking path will be presented. Various “giant molecules” based on “nano-atoms” are designed and synthesized. “Nano-atoms” refer to shape-persistent molecular nanoparticles (MNPs) such as fullerenes, polyhedral oligomeric silsesquioxanes, polyoxometalates, and folded globular proteins, and others. These “nano-atoms” possess precisely-defined chemical structures, surface functionalities and molecular shapes, which serve as elemental units for the precision synthesis of “giant molecules” via methods such as click chemistry and other efficient chemical transformations. These “giant molecules” include, but are not limited to, giant surfactants, giant shape amphiphiles, and giant polyhedra. These “giant molecules” can assemble into diverse highly ordered building blocks (spherical and non-spherical) to further construct the thermodynamically stable and metastable hierarchical structures in the bulk, thin-film, and solution. Unconventional nanostructures can be obtained in various environments to exhibit specifically desired properties. This approach has provided a versatile platform for engineering nanostructures that are not only scientifically intriguing, but also technologically relevant.

报告人简介：

程正迪教授，美国工程院院士，现任华南理工大学分子科学与工程学院院长，华南理工大学软物质科学与技术高等研究院院长。2018 年七月前，任 Akron 大学 Frank C. Sullivan 杰出科研教授，Robert C. Musson 教授和 Trustees 教授。1985 年于 Rensselaer Polytechnic Institute 获博士学位。2007 年至 2014 年任美国 Akron 大学高分子科学与工程学院院长。程教授的研究广泛涉及高分子凝聚态和液晶体系的各个领域。他长期研究平衡及非平衡软物质相转变中的热力学与动力学以及不同空间、能量和时间尺度下的结构和分子运动的相互关系，致力于将高分子和液晶体系的基本物理特征与材料的特殊性能联系起来。同时对显示器光学薄膜、光学通讯等高科技的开发及商业化起了决定性的作用。近十年来，他更进一步开辟了基于纳米原子的巨型分子的研究领域，系统发展了多层次选择性组装以实现杂化功能材料的新思路，为高分子科研提供了新的方向。迄今在国际学术刊物上发表 SCI 收录论文 550 余篇，总引用率 19000 余次，H 因子为 76。在国际和国内学术会议上做邀请报告 800 多次。他申请美国和世界发明专利 14 项。他著有学术专著《Phase Transitions in Polymers: The Role of Metastable States》。 他获得了多项奖励及荣誉称号，包括 Presidential Young Investigator Award (White House & NSF，1991), John H. Dillon Medal (APS, 1995), Mettler-Toledo Award (NATAS, 1999), TA-Instrument Award (ICTAC, 2004), PMSE Cooperative Research Award (ACS, 2005), Polymer Physics Prize (APS, 2013)，影响世界华人大奖（2014）等。他现在是中国化学会荣誉会士，美国国家发明者院会士，美国物理学会会士，美国科学发展协会(AAAS)会士， 美国化学会高分子材料科学与工程分会会士。2008 年被选为美国工程院院士。他也是国际刊物《Polymer》的总主编。