THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT COLLOQUIUM SERIES PRESENT:

Oleg Gang

Professor
Department of Chemical Engineering and Department of applied Physics and Applied Mathematics, Columbia University

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Programmable Nano-Systems: form Designed Architectures to Controllable Processes

The ability to organize nano-components into the desired organizations is one of the major limitations for creating functional material systems. Our efforts are focused in establishing a broadly applicable DNA-based platform to address this challenge. DNA provides versatile means for interaction encoding, and much progress was achieved in the recent years in our ability to tailor DNA structures. However, it is challenging to prescribe the behavior of the entire nanoscale system, built from DNA and other biotic and abiotic components, and to translate advances in DNA structuring into a material design.

Our research explores approaches for creating targeted static and dynamic nano-architectures by bridging DNA-encoded nano-objects with structural plasticity and programmability of DNA macromolecular constructs. Through establishing assembly processes and revealing the principles governing systems with DNA-encoded interactions, we develop methods for creation of well-defined three-dimensional lattices, two-dimensional membranes and finite-sized clusters from the multiple types of the nano-components. Our recent progress demonstrates an integration of DNA with both inorganic and biological nanocomponents into well-defined objects, and a new platform for the formation of ordered materials with engineered organizations and compositions. Our current advances of using programmable assembly for a fabrication of targeted nanomaterials, and exploring their optical, mechanical, and chemical functions will be also discussed. Finally, as a next level of a system control, we investigate how to regulate dynamic processes in these self-assembled systems.

Oleg Gang is a Professor of Chemical Engineering, and of Applied Physics and Materials Science at Columbia University, and a Leader of Soft and Bio-Nanomaterial group at Brookhaven National Laboratory. His research explores the behavior of soft matter at the nanoscale and develops novel strategies for programmable assembly of targeted nanomaterial. Dr. Gang earned Ph.D. from Bar-Ilan University and was a postdoctoral Rothschild Fellow at Harvard University. He joined Brookhaven National Laboratory (BNL) as Distinguished Goldhaber Fellow in 2003, where he became a leader of Soft and Bio-Nanomaterials group at the BNL's Center for Functional Nanomaterials in 2008. Dr. Gang has joined Columbia faculty in 2016. His group develops new strategies for creating materials by design using self-assembly approaches, explores phenomena and properties of newly developed nanomaterials, as well as employs advanced in-situ probes for understanding a material formation. Gang has received numerous awards and recognitions, including Gordon Battelle Prize for Scientific Discovery and Department of Energy Outstanding Mentor Award, and he is a Fellow of American Physical Society.

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