

Special Issue Dedicated to Chad Mirkin: 20 Years of Influential Research

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Guest-Editors of this Special Issue

Nanotechnology is a rapidly evolving and dynamic field, with explosive growth occurring over the past twenty years. Chad Mirkin has been at the forefront of this discipline over this period, making key contributions in a number of areas including nanofabrication, therapeutics, and diagnostics. Chad Mirkin started his research group at Northwestern University in 1991, focusing initially on surface assembly. Soon after, he began his research in the area of nanoparticles, a research theme that is still going strong in his group. This research has spanned the gamut from his initial fundamental studies on nucleotide-mediated particle assembly through to the development of DNA-based diagnostics that are now in the clinic. This research has broadened more recently to include therapeutics and theragnostics, extending the theme of nucleic acid–nanoparticle systems to new spheres of nanomedicine.

In parallel with their work on nucleic acid systems, the Mirkin group has been actively involved in the area of nanofabrication. In 1999, 40 years after Richard Feynman spoke of the “world that is

below”, Mirkin and co-workers printed part of his lecture in nanoscale letters utilizing dip-pen nanolithography, a technique made possible by atomic force microscopy. Dip-pen nanolithography provides a level of spatial and chemical control that remains unrivaled to this date, and which is enabling new technologies.

We have assembled this issue to recognize the first twenty years of Chad’s research program and the accomplishments he has made over these two decades. In recognition of the breadth of Chad’s research program we have cast a broad net, assembling an issue featuring leading researchers in a range of areas. At the interface between chemistry and nanotechnology, supramolecular chemistry is at the heart of the Mirkin group’s efforts. This versatile methodology is demonstrated by original contributions in the area of nanomaterials self-assembly by O’Reilly, Ivanisevic, and Rosi. Stellacci describes the use of nanoparticle receptors, while the creation of complex nanostructure motifs based on organic scaffolds is the focus of contributions by Gianneschi, Kotov, and Gracias. Inorganic nanostructures are likewise represented by original contributions by Yang and Mallouk.

As illustrated on the cover, the Mirkin group has a long-standing interest in the area of devices and functional materials. This thrust is represented by functional studies of a variety of materials, including graphene (Zhang), nanoparticle electron transfer (Kubiak), gold nanopyramid

optical properties (Odom), and the fabrication of nanomotor “swimmers” (Wang). The properties of more extended structures are also explored, including polymersomes (Battaglia) and membrane systems (Yang). In research building directly upon the dip-pen process pioneered by the Mirkin group, Hirtz quantifies mass transfer in the writing process.

Nanomedicine is a core focus of the Mirkin group, and we have contributions in delivery, imaging, and diagnostics. We have reviews on fundamental aspects of nanoparticle-based systems in biology, focusing on particle design (Wang) and monolayer structure (Rotello). Delivery of a variety of payloads is represented, including nucleic acids (Lytton-Jean and Caruso) and drugs (Sailor, Wooley, and Mitragotri). Nanoparticles can also serve as therapeutics in their own right (Feldheim), and as model payloads (Krpetic). Imaging is not forgotten, with contributions to radioisotope labeling (Nam), MRI contrast agents (Lin), and single-particle imaging studies by Matoussi. Finally, examples of nanosensing of DNA (Thaxton), sugars (Simon), ions (Liu), and proteins (Ginger) are presented, along with blood sensors (Ivanisevic) and versatile, barcoded, upconverting nanoparticles (Stucky).

We sincerely hope that you enjoy this issue dedicated to the first twenty years of Chad’s independent career. The Mirkin group has been a dynamic force in nanotechnology, and we look forward to many further years of innovation, evolution, and revolution.

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