Nanostructures with Transformative Implications in Biology and Medicine

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The novel architectures and properties of nanostructures make them extremely useful in many areas of biology and medicine. We have invented and developed a suite of methods for designing, synthesizing, and investigating a wide variety of nanostructured materials, including those based on bioconjugate chemistry, scanning probe lithography, and stereolithography. Examples include spherical nucleic acids (SNAs), dip-pen nanolithography (DPN) and related cantilever-free techniques (Polymer Pen Lithography (PPL) and Beam Pen Lithography (BPL)), and high-area rapid printing (HARP). These platforms permit exceptional control over 2- and 3-D architecture, sometimes in high-throughput, and they have enabled significant advances in biodetection, gene regulation, and immunotherapeutics for diseases spanning many forms of cancer and infectious disease (e.g., COVID-19). They also have impacted the development of drug screening, tissue engineering, and cellular analysis and manipulation. Several aspects of medicine and the life sciences have been transformed through the development and application of these techniques, and this presentation will provide a survey of them, from the benchtop to the clinic.