RESEACH INTEREST

Our research goal is to achieve programmed design and assembly of biologically inspired nanomaterials with the applications in nanoelectronics, photonics energy harvesting, controlled macromolecular interactions and biosensing. The research program is highly interdisciplinary combining Chemistry, Biology, Physics and Material Science.

The first mission is to explore complex and dynamic self-assembly using DNA as programmable molecules. We are interested in bottom-up engineering of sophisticated 2D and 3D nanoarchitectures.

The second mission is to engineer the assembly of biomolecules onto DNA scaffold with the finest control of spacing parameters (position and orientation) to construct interactive chemical or biological networks. We are now interested in understanding the substance transfer between surface-associated enzyme cascades and its effect on catalysis. Mechanistic analysis is performed by correlating the functional activity with the geometry pattern of multi-component cascades assembled on DNA origami. We further aim to develop DNA-based heterogeneous surfaces and nanoreactors that can be applied to biocatalysis and diagnostics.

Our third mission is to develop DNA-based nanoarrays for sensitive diagnostics and therapeutics. DNA nanoarrays with incorporation of bimolecular probes and markers will provide a platform for multi-pixel detection of nucleic acid, protein and other metabolic-relevant molecules at single-molecule level. We are also interested in constructing multi-functional nucleic acid nanostructures targeting specific cellular biomarkers for potential applications in cancer therapy and drug delivery.

Our last mission is to assemble multi-component and multi-functional nanoparticle and nanowire materials for biosensing, imaging and energy applications. Metallic and semiconducting nanoparticles possess unique optoelectrical properties. DNA-directed assembly of nanoparticles with organized surface patterning provides an ideal platform to study the collective information of nanomaterials and may exhibit new photonic properties with possible applications in massive fabrication of novel nanodevices.