Continuous Chirality of Self-Assembled Nanostructures for Chiral Photonics

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The early observation of strong circular dichroism for individual nanoparticles (NPs) and their assemblies have developed into a rapidly expanding field of chiral inorganic nanostructures. They encompass a large family of mirror-asymmetric 3D constructs from metals, semiconductors, ceramics, and nanocarbons with multiple chiral geometries with characteristic scales from *Ångströms* to millimeters. Their photonic properties care can cover multiple separate bands[1–3] and reach high g-factors,[4,5] but particle-based optical materials with continuously tunable light polarization properties are currently unknown. Building on the previous studies of complex chiral nanostructures, this presentation will show that assembly of inorganic nanoparticles can address this challenge producing the hierarchical assemblies with finely tunable 3D geometries, chirality

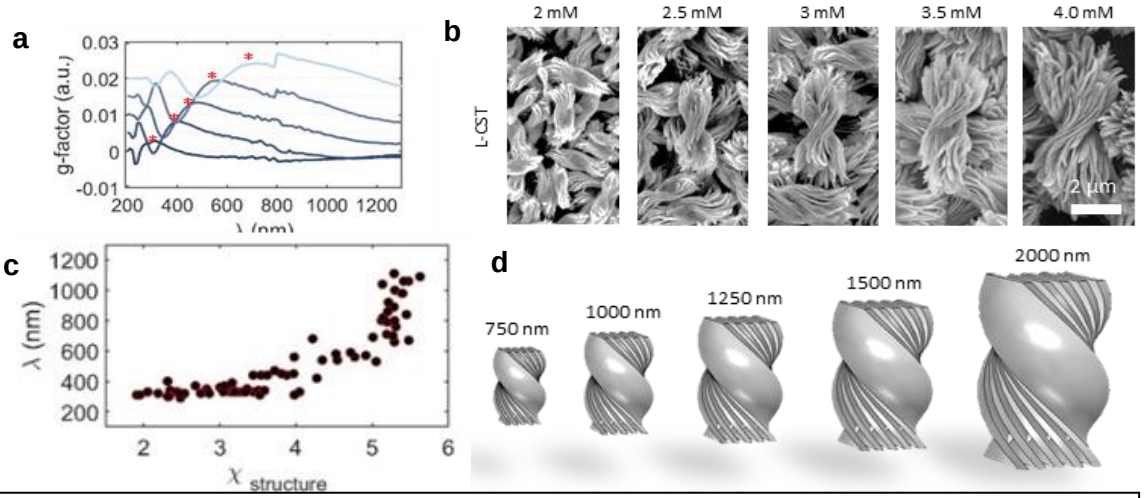

Figure 1. Continuum of chiral shapes in self-assembled bowties and their photonic properties. (**a**) g-spectra, (b) scanning electron microscopy images, (**c**) Osipov-Pickup-Dunmur chirality index, and (**d**) computational models for computing polarization rotation.

measures and photonic bands (**Figure 1**). The continuum of chiral states was made possible by 'dialling' the strength and asymmetry of interactions of Cd-based NPs spontaneously assembling into nanostructured bowties with uniform size and shape. They are made from the stacks of twisted sheets assembled into microscale particles with strong optical activity. Controllable pitch, length, width, and thickness leads to tunable chiroptical activity across from UV to IR, which can contribute to chiral photonics exemplified by the NIR coatings for machine vision that will be demonstrated in preliminary data during the workshop.

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Bio:

Nicholas A. Kotov received his degrees from the Moscow State University with his diploma and PhD studies centered on bioinspired harvesting of solar energy. His postdoctoral studies at Syracuse University encompassed the synthesis and self-assembly of biomimetic nanocomposites. After taking an Assistant Professor position at Oklahoma State University, he expanded the field of biomimetic processes and materials by establishing a research program on self-assembly of nanostructures. Nicholas is currently Irving Langmuir Distinguished University Professor of Chemical Sciences and Engineering at the University of Michigan. He heads the laboratory and international team of scientists working on practical implementations and theoretical foundations of biomimetic nanostructures. Self-assembly and optical properties of chiral nanoparticles and their superstructures represent a focal point for the continuum of bioinspired nanoscale materials with multidisciplinary significance to physics, chemistry, biology, and medicine. Nicholas is a co-founder of five startup companies and a passionate advocate for scientists with disabilities.