NANO HIGHLIGHT
NIRT: Total Chemical Synthesis, Modeling and Property Study of Nanoparticle/Polymer Hybrid Materials

NSF NIRT Grant 0506531

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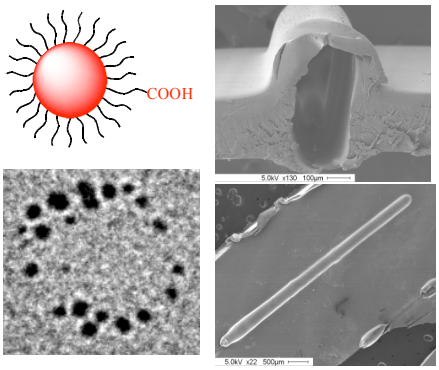
The objective of our research is to study and develop nanoparticle hybrid materials with controlled optical, electrical and thermal properties. In the bottom-up approach towards nanomaterial development, two very important aspects need to be addressed: one is the synthesis of nanobuilding blocks and the other one is how to assemble the nanobuilding blocks together into materials or devices with ideal structures, properties and functions. The property of a nanomaterial is not only dependent on the individual nanobuilding blocks, but is also affected dramatically by the architectural organization of the nanobuilding blocks and their interactions. Our research attempts to solve a few important problems associated with nanoparticle research: (1) Size and chemical functionality control of nanoparticles; (2) Assembling of nanoparticles into well-defined architectures through chemical reactions; and (3) Property study and application development of nanoparticle assemblies and nanoparticle/polymer hybrid materials.



Our team developed a unique synthetic methodology to prepare nanoparticles with a single functional group attached to the surface. Such monofunctional nanoparticles can be used as molecular building blocks and sophisticated nanoparticle assemblies could be developed from simple chemical reactions of monofunctional nanoparticles with organic molecules or polymers. As demonstrated in our research, we prepared nanoparticle wires, nanoparticle necklaces and nanoparticle clusters by a one-step chemical reaction of monofunctional nanoparticles with linear, cyclic polymers and dendrimers. From a nanoparticle/polymer hybrid material, we discovered enhanced nonlinear optical properties and important electromagnetic interactions between nanoparticles upon photo excitation. By incorporating metal nanoparticles into a polymer matrix, we developed a direct laser writing technique for microstructure fabrication. Gold nanoparticles convert the photon energy from laser beam into thermal energy, which subsequently introduce the chemical decomposition of polymer matrices. In summary, our research has been aimed at addressing both fundamental challenges and application development of nanomaterials using bottom-up approach.

References:

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