Announcing the Final Examination of Xuejun Zhang for the degree of Master of Science

Time & Location: November 5, 2010 at 3:00 PM in Materials Characterization Facility (MCF) 304
Title: Branched and Spiral Organic Nanotubes based on the Self-Assembly of Bile Acids

The self-assembly of chiral amphiphilic molecules in aqueous solutions is of particular interest because the chirality of individual molecules is often expressed in their supermolecular structures. Self-assembled tubes made of chiral amphiphilic molecules represent useful supramolecular architectures which hold promise as controlled release vehicles for drug delivery, encapsulates for functional molecules, and nanoreactors for chemical reactions. Lithocholic acid (LCA) is LCA is a secondary bile acid with the concentration being identical to that of cholesterol in the hepatic bile and gallbladder. It has a rigid, nearly planar hydrophobic steroid nucleus, with four hydrogen atoms and one hydrogen group directed toward the concave side, and the convex side with three methyl groups. The ionic head with a carboxyl group is linked to the steroid nucleus through a short alkyl chain.

In this thesis work, I study the self-assembly behavior of LCA at the liquid-solid interface, in confined spaces, and bulk solution. We find that the initially formed LCA vesicles further assemble into fractal tubes on glass slides by diffusion-limited aggregation and pronglike tubes by the capillary flow generated in an evaporating vesicle solution confined by two parallel glass slides. While in bulk solution, the LCA vesicles linearly aggregate and fuse into spiral tubes at pH 12.0. The spiral tubes can transition into a straight shape as the pH of solution is reduced to 7.4. The shape transition of the tubes is reversible as the pH of solution is adjusted back to 12.0. The pH-switchable shape transition suggests that the self-assembled LCA tubes can act as a supramolecular chemical spring.

Finally, the LCA tubes are endowed with optical functionality by embedding cadmium sulfide nanoparticles (CdS) in the tube walls by the co-assembling synthesis of cadmium sulfide (CdS) nanoparticles embedded in lithocholic acid (LCA) membrane walls. The fluorescent composite tubes can undergo pH switchable spiral/straight transition. The fluorescent composite tubes with pH-controlled shapes are a promising system for a variety of materials and biological applications.

Major: Materials Science and Engineering

Educational Career:
Bachelor's of Chemical Engineering, BS, 1999, Qingdao University of Science and Technology
Master's of Materials physical Chemistry, MS, 2002, Nankai University

Committee in Charge:
Jiyu Fang, Chair, Mechanical, Materials AND Aerospace Engineering
Linan An, Mechanical, Materials AND Aerospace Engineering
Andre Gesquiere, Nanoscience Technology Center & Department of Chemistry

Approved for distribution by Jiyu Fang, Committee Chair, on October 15, 2010.

The public is welcome to attend.