

4bu Synthesis and Applications of Nanostructured Materials

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The templated sol-gel process is a popular process to synthesize nanoporous materials. Different templates have been used, which include surfactants and block polymers. It is only recently that fluorinated surfactants have been employed in this process. Most of the work has been focused on the synthesis of nanoporous silicas by using these surfactants as templates. These surfactants, however, have potentials to fabricate other nanoporous transition metal oxides. One advantage for these surfactants is that they could be recycled by S.C. CO₂, which is highly desirable to commercialize this process.

The second aim of my research is to synthesize nanoparticles through the sol-gel process. Metal oxides with different sizes and shapes will be controlled by using different reaction conditions. Physical and chemical properties of these nanoparticles will be investigated in the relationship of the particles' sizes and shapes. Functionalized particles may be potentially used to build macro-scale materials such as organic-inorganic membranes.

The third aim is to fabricate organic-inorganic hybrid (nanocomposites) fuel cell membranes. Hybrid membranes with both high thermal stability and good proton or CO₂ exchange capability will be fabricated. Different strategies will be applied to fabricate hybrid membranes with uniform distributions of organic and inorganic parts.