Sustainable Nanoparticles

Catalytic processes are absolutely central to the petroleum industry and metallic nanoparticles possess unique catalytic activity not observed in the analogous bulk materials.[i] The petroleum industry benefits from these properties of nanoparticles. For example, supported gold nanoclusters display unique activity for CO oxidation; Pd nanoparticles have shown high activity for NO reduction by CO. and cobalt nanoparticles are ideal for Fischer-Tropsch synthesis. Transition metal nanoparticles have also been employed in a variety of synthetic organic processes.[ii] This project is a direct outgrowth of our existing work on "smart" solvents.

Reverse-micelles are being equipped with a "built-in" separation capability that can be used for the synthesis of nanoparticles, where the "built-in" separation trigger can be activated to facilitate the separation/purification step, reducing energy, additives and solvent consumption. The reaction system (structure of the components of the reverse micelles and solvent) for the formation of these nanoparticles is tailored for each application. The synergy between chemistry and engineering greatly enhances the development of new chemistry and new processes.

While we have already demonstrated the switchability of the formation and destruction of reverse-micelles upon external stimuli (heat), in this project we explore the synthesis of metallic nanoparticles. We are studying the preparation, separation/purification and deposition of nanoparticles in different solvent systems including both hydrocarbons and carbon dioxide as shown in Figure 1. Further we are also addressing the recyclability of the system. Finally the catalytic activity of the particles will be evaluated with two model reactions and compared to the data for nanoparticles synthesized by more conventional synthetic procedures.[iii]

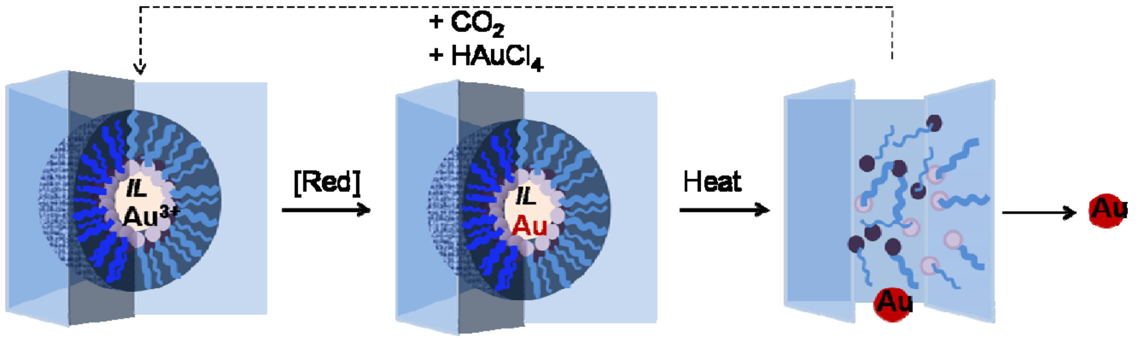

Figure 1. Reverse-micelles with "built-in" separation capability for easy and efficient synthesis, separation and purification of metallic nanoparticles.

This unique technology has the potential to revolutionize the manner in which nanoparticles are prepared. Controlled size and morphology of the nanoparticles with narrow dispersity is a prime goal. Further, we are optimizing processing and purification — overall providing sustainable processes for nanoparticles generation and use.

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