Center for Soft Matter and Biological Physics

Discussion Meeting

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"Polymer-Stabilized Colloidal Catalysts: Role of Polymers and Strategies for Recovery and Reuse"

Friday, April 26, 2019

4:00pm - 5:00 pm

304 Robeson Hall

Gold nanoparticles (AuNPs) have attracted enormous attention due to their unique catalytic activities. Colloidal AuNPs provides the benefit of selectivity, greater surface area per mass of catalyst compared to supported catalysts, catalyzes reactions under mild conditions and are very effective for chiral catalysis. On a per metal basis colloidal AuNPs demonstrate higher catalytic activity than their supported counterparts. Colloidal AuNPs however requires surface functionalization with ligands to prevent aggregation which causes surface passivation and significant reduction in catalytic activity. Colloidal AuNP catalytic activity is strongly dependent on ligand packing and conformation on the AuNP surface. Large polymeric ligands demonstrate increase in available surface area leading to increased catalytic activity, while small molecule ligands lead to complete AuNP surface passivation. A major drawback of colloidal AuNPs as catalysts is the catalyst recovery from the product stream. We have employed small pH sensitive ligands as AuNP stabilizers to show that AuNPs can be recovered from the product stream by altering the pH to selectively precipitate or phase transfer catalyst into organic solvents. However, due to the high small molecule packing density on AuNP surface, complete surface passivation was observed. Catalytic activity could be recovered by partially functionalizing the AuNP surface, however at the cost of recoverability. To maintain catalytic activity in recoverable catalysts, we have developed pH sensitive polymer ligands by synthesizing thiolated polymer ligands. AuNPs functionalized with thiolated polymer, demonstrate similar recoverability while retaining high catalytic activity. Application of colloidal AuNP as catalysts, thus entails fine tuning ligand MW, structure, catalytic activity and recoverability.