Final report of work done on the UGC-Major Research Project

Title of research project : **"Physicochemical Properties of Block-co-polymers and Evaluation of their Capping Behavior in Nanoparticle Synthesis".**

UGC Reference No. : **F. 34-323/2008(SR)**

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SUMMARY OF THE FINDINGS:

This study concludes that surfactant-assisted aqueous phase synthesis of PbSe and CuSe nanoparticles produces well-defined plate like morphologies. A stronger hydrophobic surfactant produces thin morphologies in both cases. Selective adsorption of surfactant monolayer on {100} crystal planes determines such morphologies and forms a shell around each nanoparticle. PbSe reaction also produces fine long Se nanorods as a reaction by product which is not observed in the reaction of CuSe. The present study provides a simple aqueous phase method for the synthesis of fine platelike PbSe and CuSe nanoparticles(NPs) under mild reaction conditions which can find applications in the semiconductor industry.

It is also concluded that reduction is carried out by the surface cavities produced by the compact arrangement of TBP monomers in the corona layer of TBP micelles. Because the redox reaction is a site-specific reaction and takes place only at the micelle-solution interface, the extent of hydration of the surface cavities is the rate-determining step. Greater hydration screens the approach of gold ions and hence reduces the nucleation process, but the same reaction is accelerated when an appropriate dehydration is achieved. The large NPs obviously cannot be supported by the soft micelles and hence find their way into the bulk phase. If the micelles are large enough, especially when a higher concentration of a TBP is used, then they tend to carry them. Therefore, the overall shape and structure of a TBP micelle is the central issue in the successful redox process and are strongly related to the temperature variation.

We also showed that the unfolded BSA can also be used to synthesize Au NPs in vitro by using different conventional surfactants. All NPs are stabilized by BSA coating, while different surfactants only participated in the unfolding process of BSA. BSA coated NPs do

not show any hemolytic response and hence can be used as vehicles for drug release in systemic circulation. In contrast, surfactant capped NPs show significant hemolytic as well as cytotoxic responses. In terms of nanotoxicity, our results conclude that if nanopollutants find their way into the bloodstream, they are expected to be complexed by the serum albumin and hence will not be toxic. This opens up several possibilities for BSA coated NPs to be used in various biomedical applications, which require their intravenous administration.

Papers Published:

1. Surface Activity of Highly Hydrophobic Surfactants and Plate like PbSe and CuSe Nanoparticles
   M. S. Bakshi, P. Thakur, **Poonam Khullar**, G. Kaur, T. S. Banipal.
   Journal of Crystal Growth and Design, 10, 1813-1822, 2010.

2. How PEO-PPO-PEO Triblock Polymer Micelles Control the Synthesis of Gold Nanoparticles: Temperature and Hydrophobic Effects
   Poonam Khullar, A. Mahal ,V. Singh, T. S. Banipal, G. Kaur, M. S. Bakshi.
   Langmuir 26, 11363-11371, 2010.

3. Bovine Serum Albumin Bioconjugated Gold Nanoparticles: Synthesis, Hemolysis, and Cytotoxicity toward Cancer Cell Lines
   Poonam Khullar, V. Singh, A. Mahal, P. N. Dave, S. Thakur, G. Kaur, J. Singh, S. S. Kamboj, M. S. Bakshi.
   J. Phys. Chem. C, 116, 8834−8843, 2012.

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