IBN Pioneers Breakthrough Method in Nanoparticle Synthesis

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The Institute of Bioengineering and Nanotechnology (IBN) has developed a novel method to simultaneously control the size and morphology of nanoparticles, which can be used in pharmaceutical synthesis and novel biomedical applications.
Research Scientist Dr. Yu Han and IBN Executive Director Prof. Jackie Y. Ying have developed a fluorocarbon-mediated-synthesis technique that produces nanometer-sized particles of between 50 and 300 nm with tunable pore sizes in the range of 5-30 nm.

This groundbreaking research was featured in the leading Chemistry journal, Angewandte Chemie, and a United States patent has been filed on the invention.

“The nanoporous nanoparticles are named after our Institute, termed ‘IBN-1’ to ‘IBN-5’. They represent a new class of materials that are tailored simultaneously with nanometer-scale particle size and nanometer-sized pores. This is a beautiful example of ‘bottom-up’ nanotechnology made possible by supramolecular chemistry,” said Prof. Ying.

Previous attempts at synthesizing such nanoparticles created particles that were limited in the type of structure, degree of structural ordering and range of pore sizes. Most current technologies can only produce 2-dimensional hexagonal structure with small pore diameter (

IBN’s simple wet-chemical technique uses two different types of surfactant (a soluble chemical compound that reduces the surface tension

between liquids). One surfactant acts as the template for mesoporous structure, while the other is used to limit the growth of the particles to nanometer dimensions.

This method can be used to create a variety of nanoparticles with enormous surface areas, and very well-defined pore size and structure.

One important application of these nanoporous nanoparticles lies in the production of pure chiral drugs, which make up over one-third of all pharmaceutical drugs currently sold worldwide. Chiral drugs are comprised of “left-handed” and “right-handed” molecules, both of which are mirror images of each other. Only one of these molecules provides the therapeutic effect. In the production process, catalysts are used to selectively synthesize the preferred chiral molecule that provides for therapeutic treatment without undesired side-effects. However, these catalysts normally exist in a homogeneous liquid phase, which makes them difficult to be separated and reused.

Prof. Ying’s group at IBN has developed novel approaches to immobilize these catalysts on nanoporous materials synthesized by its wet-chemical technique. This renders the catalysts in a solid form, enabling them to be easily recovered and reused through simple filtering or centrifuging processes. This allows for the more efficient synthesis of a wide variety of pharmaceuticals.

This improvement in the drug manufacturing process can potentially lead to greater cost savings, as the production of the chiral ingredient currently accounts for 10-40% of the total cost. IBN’s invention could potentially have a significant impact on the chiral pharmaceuticals industry, a fast-growing sector which generated US$143 billion sales in 2003.

Other applications of IBN’s nanoporous nanoparticles involve

therapeutic treatments like targeted drug delivery and gene therapy. Nanoparticles of varying size and structure may be created to act as carriers for drugs, genes and proteins. In addition, these porous nanoparticles can be used to host quantum dots and magnetic nanoparticles for bioimaging and quantum device applications.

Source: Institute of Bioengineering and Nanotechnology