

## Editorial

Founded only six years ago, the National Center for Nanoscience and Technology (NCNST) has developed rapidly with important achievements. We invited experts of NCNST in this field to introduce the research developments by NCNST and hot issues in the relevant fields of nanoscience and technology in this special topic. The special issue covers the research results from the National Natural Science Foundation of China, Major Research Project for “Study of nanomanufacturing base”, the Ministry of Science and Technology of China, Major National Science Program for “Nanotechnology research”, and the National High Technology Research and Development Program of China for “Nano materials and devices”. We hope that these results will significantly benefit future China nanotechnology research. Because nanotechnology has a strong interdisciplinary feature, this topic involves multi-disciplinary contents of physics, chemistry, biology, medicine, electronics, mechanics, standardization, etc. rather than limited to pure materials science. Nanotechnology features mainly the following several aspects.

(1) Nanoparticle mimetics. Natural enzymes as biological catalysts possess advantages such as high efficiency and high substrate specificities under mild conditions. However, they are susceptible to influence by external environment and lose their catalytic activity via denaturation. Recently, some nanoparticles were found to exhibit catalytic activity similar to enzymes. These nanoparticles are more stable when compared to the natural enzymes and maintain stable catalytic activity in a wide range of temperatures and pH value. As large scale, low-cost syntheses can be achieved through chemical methods, nanoparticles as a new class of mimetics have aroused considerable interest of researchers. The most recent research progress in nanoparticle mimetics is introduced and the research hot spots are highlighted.

(2) Silicon nanocrystals. Crystalline silicon plays a huge role in modern technology. Monocrystalline silicon and polycrystalline silicon are leading materials in contemporary microelectronics industry. They provide a solid and reliable basis for semiconductor devices such as artificial intelligence, information processing, and photovoltaic conversion. A simple and controllable method of synthesis of nanoscale monocrystalline silicon is introduced in this special topic. Hexagonal silicon was prepared using atmospheric pressure solution method at room temperature, and a specific functional groups modification on crystal surfaces can be achieved in the reaction. This result has set up a basis for the introduction of other functional molecules and realized the functional features of silicon nanocrystals.

(3) Microporous polymers. Microporous organic polymer is a new type of porous material. It has potential applications in heterogeneous catalysis, absorption, separation and gas storage. It is an all-organic molecular building block with assembled microporous (pore size less than 2.0 nm) solid developed in recent several decades. According to the different design strategies, it can be divided mainly into the following four categories: 1) hypercrosslinked polymers, which prevent close packing of polymeric chains through crosslinking reaction; 2) self-assembly microporous polymers, which prevent close packing of polymeric chains through rigid, contorted groups; 3) conjugated microporous polymers built through large conjugated  $\pi$ -systems rigid structure; 4) covalent organic framework polymers, which are prepared through reversible condensation of appropriate functional groups. This special issue focuses on self-assembly microporous polymers and conjugated microporous polymers based on the research background both at home and abroad.

(4) Rapid spectral measurement of anode alumina barrier layer thickness. A spectral method for rapid, nondestructive anodic alumina (AAO) barrier testing is introduced. Nanoporous alumina film with uniform pore size and parallel pore canals was prepared; the transmission spectra of samples with different barrier layer thicknesses were studied using UV-visible-near infrared (UV-VIS-NIR) spectroscopy. This result provides a simple and efficient method of rapid non-destructive testing for the AAO barrier layer thickness.

(5) Gold nanoparticles as drug carrier. In recent years, much research in the usage of metal and semiconductor nanoparticles in biology, new energy and other aspects has been done. Metallic materials, especially gold nanomaterials have good stability, low toxicity and simple preparation method when compared to the semiconductor nanoparticles. This topic

reports the controllable preparation of water-soluble gold nanoparticles coated tiopronin and the latest progress in the application of non-modified gold nanoparticles to detect different types of targets, including nucleic acids, proteins, metal ions and small organic molecules.

(6) Flexible supercapacitor. As a new two-dimensional carbon nanomaterial, graphene has the prospect of a wide range of applications. This special topic reports a flexible supercapacitor based on the graphene/polyaniline nanowires self-supporting thin-film. Based on the flexible film a soft super-capacitor with a sandwich structure was assembled. Its electrochemical performance was tested.

(7) Spectroscopic reference sample of semiconductor quantum dots. Semiconductor quantum dot nanocrystals are a kind of typical nanomaterials with unique optical properties, and they have already been applied in the fields of biomedicine, photoelectrical conversion, etc. Reference samples of quantum dot nanocrystals are important to their quality control and industrial applications. This topic reports semiconductor nanocrystal quantum dots reference samples represented by cadmium selenide quantum dots, and their optical properties are evaluated.

(8) Supramolecular self-assembly networks. These supramolecular networks as molecular templates can achieve: 1) the stable adsorption of a variety of functional organic molecules; 2) monolayer dispersion and identification to fullerene molecules; 3) direct observation of photoisomerization; 4) building of one-dimensional single-molecule nanowires; 5) hetero-phase double layer nanostructure formation. These supramolecular networks are expected to become a class of useful flexible network structures in shape selective catalysis, molecular recognition and host-guest supramolecular chemistry.

(9) Studies on the N-layer graphene surface and edge properties. Graphene is a rising star in recent years in physics, chemistry and materials science. Raman spectrum and its temperature dependence on graphene and graphite are reported in this topic, and their mechanism is discussed.

(10) Unmodified gold nanoparticles for colorimetric detection. A brief summary in this topic concludes the latest progress in the unmodified gold nanoparticles used for the detection of a variety of different target substances, including nucleic acids, proteins, metal ions and small organic molecules. Their prospect in this area is viewed.

(11) Preparation of highly dispersed phosphate-modified magnetic nanoparticles and the  $\zeta$  potential characterization. The high-temperature organometallic synthesis using phosphate mixture is reported in this topic, combined with the phase transfer for the ligand exchange. Highly water dispersible  $\text{Fe}_3\text{O}_4$  nanoparticles with narrow size distribution were obtained, which showed response to the magnetic field. A systematic characterization of infrared and  $\zeta$  potential was conducted and the ligand structure was studied.

In this rapidly developing discipline nanotechnology we believe that Chinese scientists will continue to come up with more important research results. For the timely and accurate report of these new developments, *Science China-Physics, Mechanics & Astronomy* will continue to organize topics in this area. Here we welcome both domestic and overseas researchers to share their latest nano research papers in the coming topics; we also hope to promote continuous innovation and breakthrough in nanoscience and technology in China through this form of topic.

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