Front. Chem. China 2009, 4(3): 321–323
DOI 10.1007/s11458-009-0097-5

NEWS

Researches towards advanced materials in the Institute of Chemistry, Chinese Academy of Sciences (ICCAS)

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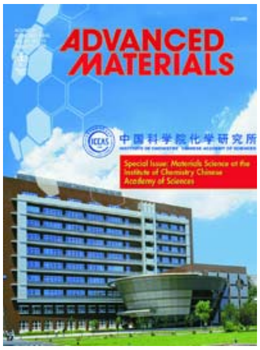
The Institute of Chemistry, Chinese Academy of Sciences (ICCAS) is a multidisciplinary research institute dedicated to basic researches on broad fields of chemical science and to the development of innovative high-technology application and technology transfer to meet strategic national needs. Through the efforts of several generations, ICCAS has become one of the leading research institutes in chemistry and related fields within the Chinese Academy of Sciences.

Since its foundation, ICCAS has been active at the frontiers of materials science and achieved lots of accomplishments. Their research topics range from polymer-based materials to nano-materials.



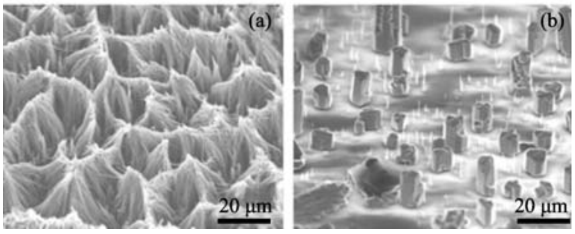
In August 2008, the scientific journal *Advanced Materials*, which was launched in 1988 and is currently one of the highest-impact journal in material sciences, published a special issue for the ICCAS (*Adv. Mater.*, 2008, Volume 20, Issue 15). The special issue, including three Review articles, three Progress Reports and 12 Research News articles, summarized the recent accomplishments of ICCAS researchers in materials sciences. The following accomplishments are contained in the special issue: 1) synthesis of carbon nanotubes and their application in nanodevices, biosensors and biofuel cells; 2) preparation of new nanomaterials and their applications in energy and environment; 3) preparation of organic nanomaterials and investigation of their unique photo-electronic properties; 4) new organic polymeric materials including the innovation of highly efficient catalyst for polymerization and polymers with unusual structures; 5) organic photo-electronic polymeric materials and their application in solar cells and biosensors; 6) molecular self-assembly and smart materials, supramolecular chirality and switch, molecular materials and devices as well as the application of molecular materials in high-density information storage.

This is the first time that *Advanced Materials* published a special issue for a research institute of China. It reflected the recognition and recommendations of the international academy for the achievements in material sciences of the ICCAS. The publication of this special issue will not only allow the ICCAS researchers to introduce their recent achievements to the scientific community, but also provide a unique opportunity for them to exchange ideas with researchers in their respective areas.

In the following, we would like to introduce some of the recent research accomplishments in the area of material sciences from ICCAS.

Ion-transfer-based growth: a mechanism for CuTCNQ nanowire formation

The researchers of the Key Laboratory of Molecular Nanostructure and Nanotechnology have recently proposed a new ion-transfer-based mechanism for the growth of CuTCNQ nanowires within the confines of an anodic aluminum oxide template. Remarkably, Cu ions are found to be moving across the growing solid single-crystalline nanowire at a very high rate with macroscopic distance. The new mechanistic understanding may provide new insights into metal-TCNQ charge-transfer complexes for further applications in organic electronics and solid state ionics. The results were published on *Advanced Materials* (2008, 20(24), 4879–4882).



SEM images of (a) CuTCNQ nanowire arrays and (b) CuTCNQ bulk crystal arrays standing upright on templates.

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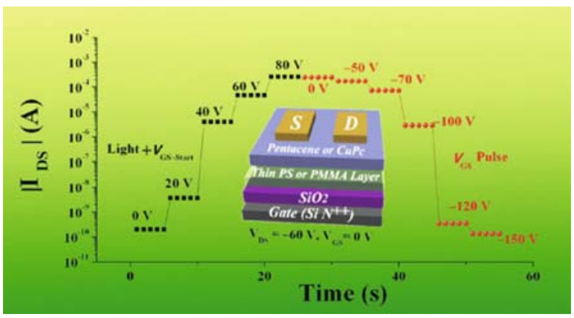
* Lin TIAN is the editor who summarizes the information contributed from ICCAS.

Multibit storage of organic thin-film field-effect transistors

Organic field-effect transistor memory is one of the most important research directions in the field of organic memory. For memory cells, most of the tradition studies focused on single-bit devices achieving low cost per bit by scaling size or multilevel storage. However, the multibit storage is attracting more and more research attention because of the scaling method limited by photolithography.

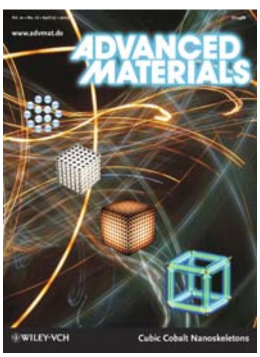
Recently, the researchers of the Key Laboratory of Organic Solids successfully developed multibit-storage organic field-effect transistor (OTFT) devices. They skillfully built a top-contact OTFT on a SiO_2/Si platform. The devices with the additional PS layer showed a good *p*-type OFET behavior and excellent multibit storage ability. These characteristics are believed to be originated from the use of optical and electrical organic semiconductors, from performing the appropriate write and erase programs, and from the charge-storage ability of the polymer (or the surface between the polymer and SiO_2). After further investigation and optimization, the OTFTs can be potentially applied in low-cost, lightweight, and high-density-bits storage devices. The results was published on *Advanced Materials* (2009, 21(19), 1954–1959).



Schematic diagram of the OTFT device and the current levels as a function of time at different photo-electric processes.

Cobalt nanoskeletons: one-pot solution synthesis of cubic cobalt nanoskeletons

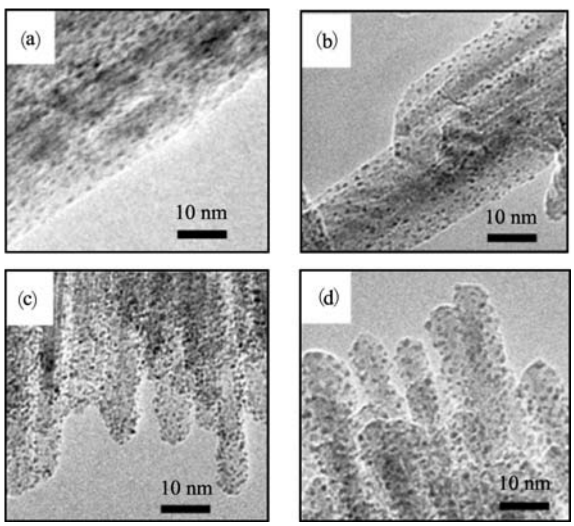
The researchers from the Key Laboratory of Photochemistry reported the preparation of cubic Co nanoskeletons with an edge length of 100 nm by a facile one-step solution method. Briefly, CoO nanoparticles of ~10 nm were subjected to self-aggregating, *in situ* reduction, Ostwald ripening, and facet-selective coordination-assisted etching to form these novel structures. Besides, these Co nanoskeletons also exhibit excellent magnetic properties. Simple control of the shape can be achieved by altering the reaction time. The cubic cobalt nanoskeletons are published as the cover picture of *Advanced Materials* (2009, Volume 21, Issue 15).



An important progress made in the preparation of metal loaded TiO_2 nanocomposites

Metal/metal oxide nanocomposites have broad application prospects in catalysis. Controlled synthesis of these materials is hence a very active and challenging field in nanotechnology research. Several approaches for the preparation of noble metal/TiO2 composites have been reported, including conventional impregnation and deposition-precipitation (DP) techniques, photodepositon, sputtering, colloidal methods, and so on. Recently, Zhimin Liu and colleagues at the Key Laboratory of Colloid, Interface and Chemical Thermal-dynamics have developed a novel and simple method to *in situ* load noble metals on TiO_2. The results was published on *JACS* (2009, 131(19), 6648–6649).

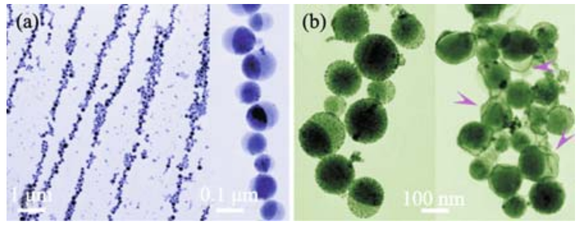
In the study, $TiCl_3$ and noble metal salts were used as the starting materials. Through a redox reaction between the reductive titanium(III) oxide support and metal salt precursors, a series of noble metal/TiO_2 nanocomposites with uniform metal dispersion, tunable metal particle size, and narrow metal particle size distribution were obtained. This method may open up a new way to prepare metal supported composites. The as-prepared metal/TiO_2 nanocomposites, which are expected to effectively catalyze some reactions under low temperature, have promising applications in catalysis.



TEM images of metal/TiO_2 composites prepared by Liu et al.

Magnetic Janus particles prepared by a flame synthetic approach

The research group of Prof. Mingyuan Gao from the Key Laboratory of Colloid, Interface and Chemical Thermaldynamics reported the preparation of spherical Janus particles consisting of γ-Fe_2O_3 and SiO_2 bicompartments through a flame synthetic route. The excellent colloidal stability of these particles offers versatile choices for further manipulating them to form different types of assembled structures. As an example, the synthesis of hollow capsules with a magnetic core and a soft Au/PVP-film shell is demonstrated. All these experiments strongly suggest that the current approach has paved a new route towards nanoparticles with novel structure and properties which may not be achieved under conventional conditions. The results were published on *Advanced Materials* (2009, 21(2), 184–187).



(a) Chains of Janus particles aligned by an external magnetic field; (b) Janus particles coated with PVP/Au nanoparticles (left) and thehollow capsules (right, indicated by pink arrows).