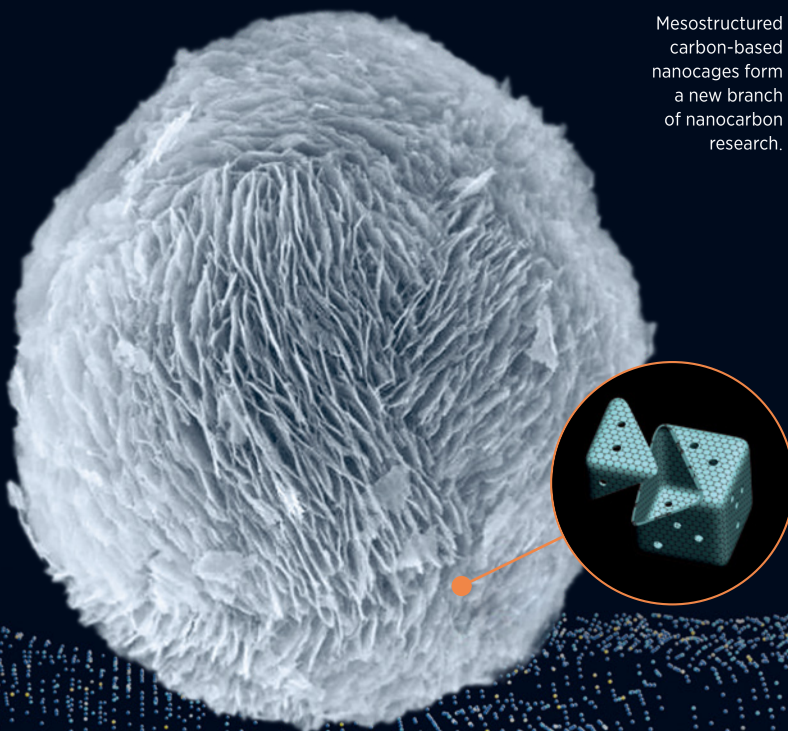
BUILDING A BETTER NANO-WORLD

NJU chemists are developing new functional materials for use in everything from energy to IT.



Mesostructured carbon-based nanocages form a new branch of nanocarbon research.

Materials are the world's building blocks. To understand their structure and composition for improved synthesis and greater use requires innovative chemical research. Chemists from the School of Chemistry and Chemical Engineering at Nanjing University (SCCE) work to create new functional materials with optimum physical or chemical properties.

Designing functional materials for energy use is the focus of a SCCE physical chemistry group, led by Zheng Hu. "Given their various structures and textures, carbon materials have been widely used in energy production, conversion, and storage," Hu said. "The discovery of nanocarbons in the past 35 years, from fullerenes to graphene, and more recently, to cyclocarbon, has thrust them into the mainstream of nanocarbon research."

Focusing on carbon-based nanomaterials, Hu's group has developed a series of mesostructured nanocages with unique characteristics. Unlike popular porous nanocarbons, Hu's nanocages feature big interior cavities, high surface area, and tuneable electronic structure, making them good candidates for electrodes in batteries. The hierarchical porous structure and conductive scaffold allow for smooth mass/charge transfer. These carbon-based nanocages, and their derivative composites, demonstrate great potential for advanced energy conversion and storage, said Hu.

The rapid development of information technology has stimulated the demand for multifunctional optoelectronic materials. Materials with both electrical and magnetic properties are in the spotlight for their potential in molecular spintronics. A team looking at molecular optoelectronic materials, led by SCCE professor Jinglin Zuo, has prepared novel conjugated ligands that can be further used in making metal complexes for the development of molecular electronics. From this type of material, they have developed redox-active and super-protonic conductive metal complexes, and revealed a new conducting mechanism of 'coupled ionic/pseudo-capacitive conduction'. Zuo's team has also exploited Fe(II)-based redox-active ligands for photo- and electronically switchable spin-crossover materials, potentially providing a foundation for new molecular electronics and magnetic devices.

Self-healing materials that can autonomically detect and repair cracks are exciting for device design because they offer extended service life, enhanced safety, and can reduce waste. Their significance and value have attracted interest from a group of SCCE researchers led by Chenghui Li. Inspired by natural biomaterials with intrinsic self-healing ability, Li's group has designed and synthesized many polymers. Harnessing the unique features of coordination bonds, they have developed materials with excellent mechanical properties, as well as self-healing performance. Highly stretchable, tough, and rigid, these novel materials have wide applications as adhesives, sealants, coating, potting or encapsulation compounds for use in electronics, aerospace or defence industry.

Functional materials based on supramolecular self-assembly is another focus of SCCE researchers. A research team led by Leyong Wang and Xiaoyu Hu, is engaged in applying supramolecular chemistry to develop smart materials. They have developed a supramolecular nanocomposite hydrogel film that can be used for thermochromic smart windows. This film automatically adjusts to ambient temperature, turning from transparent to opaque when heated, maintaining a comfortable indoor temperature, while saving energy. The team has also designed a light-harvesting system that mimics natural photosynthesis. ■