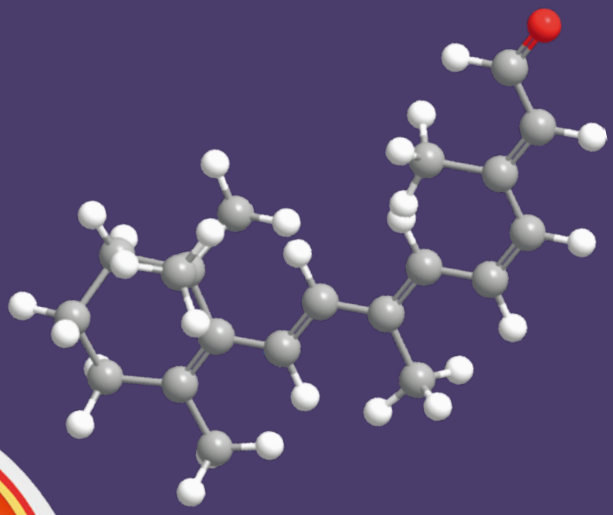
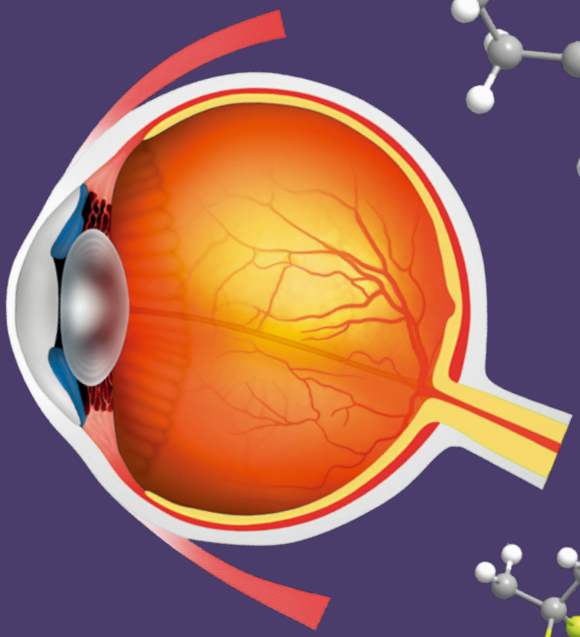
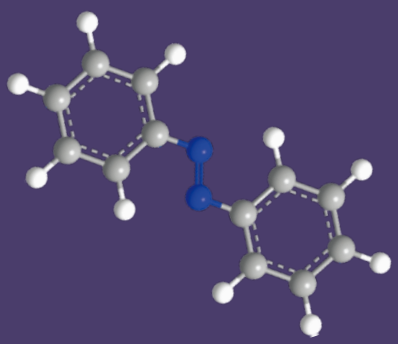
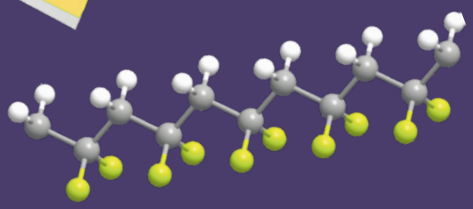
BIOMEDICAL EXCELLENCE YIELDS NEW TOOLS

The integration of chemistry and biology offers new tools to advance biomedicine.









Inspired by photo-sensitive molecules in natural retina, SCCE researchers have developed materials for artificial vision.

Rapid advances in chemistry and its integration with biology have seen great leaps in biomedical innovation. At Nanjing University's School of Chemistry and Chemical Engineering (SCCE), studies on the chemical biology of metals, molecular probes for biosensing and diagnosis, and biomaterials for drug delivery, have led to the development of new tools for biomedicine, advancing basic and translational research.

Metals are the key to many physiological and pathological processes. Precise detection of endogenous metals in living bodies and understanding their biological functions help with the development of metallodrugs. Realizing the potential of platinum-based drugs in cancer treatment, a SCCE team led by Zijian Guo, a member of the Chinese Academy of Sciences (CAS), has developed approaches to reveal how these drugs work. The researchers synthesized active metal complexes with novel structures, some of which can selectively target mitochondria and induce cancer cell death. These will help improve anticancer drug efficacy and overcome resistance.

Guo's team has also developed fluorescent molecular probes for detecting metals, such as zinc, copper and iron in living cells, enabling real-time tracking of the localization and dynamic distribution of metal species. He recently established a Chemistry and Biomedicine Innovation Center to assemble multidisciplinary research groups from chemistry to medicine to accelerate biomedical research.

Inspired by the potential of metalloenzymes, a team led by NJU chemist, Jing Zhao, has designed artificial enzymes to launch enzyme-like catalytic reactions. They also developed a novel bioinorganic hybrid system for photocatalytic hydrogen production under aerobic conditions.

The focus of SCCE professor, Zhen Liu, is molecularly imprinted polymers (MIPs) that can recognize a variety of biomolecules ranging from monosaccharides and proteins, to post-translationally modified proteins. He developed advanced MIPs that mimic natural antibodies and lectins, while improving stability, specificity, reusability and reducing cost, enabling important biomedical applications from single-cell analysis to disease diagnosis, and cancer nanotherapy.

Chemical tools enabling detection of tissue hypoxia are useful for early diagnosis of cancer and other diseases, as well as evaluating therapeutic efficacy. The team led by Xiqun Jiang, a SCCE professor, has developed non-invasive probes for imaging a hypoxic tumour microenvironment. Based on highly phosphorescent iridium complexes and biocompatible polymers, the probes allow for detection of primary and metastatic tumours with high sensitivity. They can even detect tumour cells in the early stage of formation, as shown in mouse models, providing a powerful tool for early diagnosis of cancer. These probes are used in imaging-guided cancer surgery and in monitoring therapeutic responses.

Using biocompatible ferroelectric polymers, Jiang is also working with his SCCE colleague, Qundong Shen, to develop all-organic, flexible, and bionic retina. These have been implanted in rabbits, rats, and rhesus macaques to replace damaged photoreceptor cell layers, and proved capable of light intensity identification, colour recognition, and even night vision and hyper-resolution imaging. "We hope our artificial retina will bring vision to millions of patients suffering from eye diseases," said Shen. ■