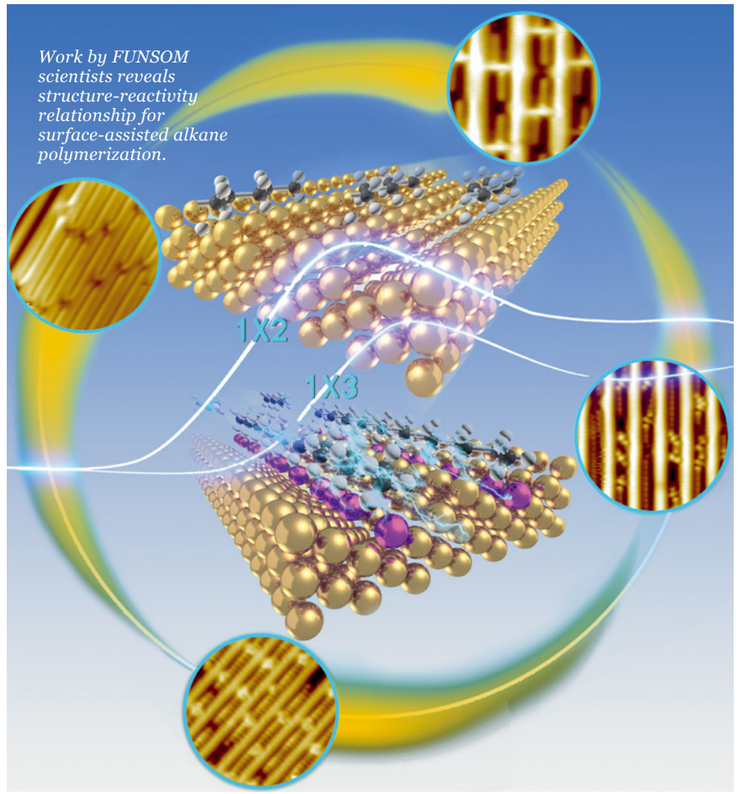
ADVERTISEMENT FEATURE SOOCHOW UNIVERSITY

A GROWING FORCE IN NANOSCIENCE

Integrating research, education, and industrial application, Soochow University's nanoscience programme is forging a new model for exploiting potential.

The 21st century has witnessed the advent of nanotechnology as a route for finding solutions to the world's most complex problems. To become a national leader in nanotechnology research and education, in 2008 Soochow University established the Institute of Functional Nano & Soft Materials (FUNSOM), an international and interdisciplinary nano-research centre. Two years later, FUNSOM spearheaded nano education by founding the College of Nano Science & Technology (CNST).

FUNSOM and CNST are dedicated to academic innovation, technological development, and the training of next-generation scientists and engineers in nanotechnology. Here, research, education, and industrialization are pursued in a 'triangle' network to push forward development and application.



Work by FUNSOM scientists reveals structure-reactivity relationship for surface-assisted alkane polymerization.

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Spearheading nanoscience research

FUNSOM's focus is on optoelectronics, new energy, green technology, and biomedicine. Its five major directions are: functional nanomaterials, organic optoelectronic devices, nanobiotechnology and nanomedicine, structured functional surfaces and interfaces, and materials simulation and genomes.

Committed to overcoming the bottlenecks in organic and perovskite light-emitting diodes (LEDs), FUNSOM professors, Liangsheng Liao and Jianxin Tang, along with their colleagues, have designed new emitting materials and device structures with high external quantum efficiency. Using novel interface engineering methods, they have precisely controlled the electroluminescent process, and achieved effective light manipulation in flexible devices. Their white-light organic LEDs have shown record efficiency. They also have China's first independent intellectual property rights on a manufacturing line for organic LED panels.

Xiaohong Zhang, Jiansheng Jie and their colleagues have systematically studied the potential of organic micro/nano single crystals for optoelectronic devices. They have developed novel methods for rationally controlling the structures, properties, and large-area patterns of organic crystals, building integrated organic transistors with unprecedented average mobility. Their work received second prize in the National Natural Science Awards.

Another team, led by Lifeng Chi, is focused on understanding the unique electronic and structural properties of functional molecules and nanomaterials influenced by surfaces and interfaces. Centred on molecular assembly and reactions, molecular patterning, and structured functional surfaces, Chi's team has come up with interesting breakthroughs, particularly in surface-assisted reactions. They have developed new concepts for on-surface synthesis of unconventional chemical reactions and constructed novel molecular nanostructures.

Focusing on nanomedicine, FUNSOM researchers also aim at improving diagnosis and treatment of diseases, including cancer, auto-immune and brain diseases, by developing various nanoprobes for biomedical imaging, and many nanomedicine systems. Silicon-based nanoprobes for fluorescence imaging and biological sensing is integral to research led by Yao He. Another team is focused on developing biomaterials and nanomedicine strategies to enhance cancer immunotherapy. A FUNSOM faculty member, Zhuang Liu, has also founded a company to translate his biomaterial-enhanced immunotherapeutic strategies for clinical use.

Through rational design and engineering of nanostructured materials, scientists at FUNSOM are also working to improve performances for a range of significant catalytic reactions. In a study published in *Science*, Zhenghui Kang and colleagues hybridized C_3N_4 with graphene quantum dots, achieving a record-high photocatalytic efficiency (2%) for water splitting.

Yanguang Li and colleagues systematically explored bismuth-based nanostructures for selective electrochemical CO_2 reduction. Establishing Bi as the most promising formate-producing electrocatalyst, they pushed its performance to the limit and achieved large current density in flow cells. Qiao Zhang and co-workers have synthesized various nanocrystals with delicately controlled shape and enhanced stability, allowing for improved catalytic properties. Particularly, their studies on Pd nanocrystals have opened an avenue for designing highly active and selective catalysts for the chemical industry.

To date, FUNSOM has attracted more than US$111.5 million from national funding agencies. Its researchers have published 1,900-plus papers in academic journals, including *Nature, Science, Nature Chemistry,* and *Nature Energy*, and have received numerous international awards and honours. Eight FUNSOM professors are editors of leading international journals. FUNSOM's contribution to nano research and its broad impacts were also highlighted in two special issues of *ACS Nano* and *Advanced Materials*.

Launching undergraduate education in nanoscience

The founding of CNST came in response to a national call to establish new undergraduate programmes linked to cutting-edge research and emerging industries. With an undergraduate-to-PhD programme in nanoscience and nanotechnology, CNST advances the training of next-generation young scientists and engineers in nanotechnology with creative thinking, interdisciplinary background, and global vision.

The interdisciplinary nature of nanoscience and nanotechnology means it is vital to integrate various streams of engineering and science, said CNST dean, Shuit-Tong Lee. In line with this, CNST offers bachelor degrees respectively in nanodevices and nanoelectronics, nanomaterials and nanochemistry, and nanomedicine and nanobiotechnology. At the master's and doctoral levels, students may be enrolled from physics, chemistry, materials science and engineering, as well as biology, allowing an interdisciplinary environment for learning.

Globalization is another key feature of CNST, with an international curriculum and courses taught in English. Collaboration has been established with more than 40 international institutions from 21 countries for joint education and research.

In just 10 years, more than 1,000 graduates have come through CNST/FUNSOM, many of whom have emerged as leading scientists and engineers in nanotechnology, including six recognized as 'Highly Cited Researchers' by Clarivate Analytics in 2019.

Integrating nanotechnology industry with education and research

Technology transfer is another essential component of FUNSOM's aim. Committed to transforming cutting-edge research into real-world services and technologies, FUNSOM, with the support from local governments and other institutes and universities, established the Collaborative Innovation Center of Suzhou Nano Science and Technology (NANO-CIC), which became one of the first 14 national collaborative innovation centres in 2013.

Within a decade, FUNSOM faculty members have established eight enterprises, having brought many technologies to market. One example is the Institute of Organic Optoelectronics (IOO), jointly established by FUNSOM, Jiangsu Industrial Technology Research Institute (JITRI) and the local government. It has, for instance, seen successful commercialization of the OLED technologies developed by Lee, Liao and Tang's team into indoor lighting products, micro-OLED displays for VR and AR devices, and automotive tail lamps. Focusing on developing optoelectronic materials, manufacturing equipment and OLED technologies, IOO bridges the gap between academia and industry by promoting technology transfer and innovation.

The founding of FUNSOM marked the emergence of the discipline of nanoscience and technology at Soochow, which has become a bedrock of the university. The fast growth of FUNSOM/CNST also drives the development of other related disciplines at Soochow University, such as materials science and chemistry, both of which were ranked among the global top 1‰ by Essential Science Indicators (ESI) since 2017. In 2019, Soochow University was ranked 37th globally in materials science, compared with 529th in 2011, according to ESI. Capitalizing on its fast-growing international reputation, FUNSOM will continue to advance the education, research and technology transfer in nanoscience and technology, and promoting the international reputation of Soochow University. ■

FUNSOM/CNST milestones

2008

Shuit-Tong Lee, a member of the Chinese Academy of Sciences, became the founding director of FUNSOM

2010

CNST founded, with Lee as its first dean

2011

CNST approved as one of the first 17 National Pilot Colleges

2013

Led by FUNSOM, NANO-CIC founded

2016

IOO established

2019

Nine FUNSOM professors listed as Clarivate Analytics 'Highly Cited Researchers'

Rapid development

FUNSOM/CNST has attracted a wealth of outstanding talents from all over the world to drive innovation and industrialization in nanotechnology. Today, it boasts:

- 79 faculty members, including 42 principal investigators
- 428 undergraduates, 423 master's and 123 Ph.D. students
- A total lab space of 19,700 square metres
- Ranked 11th globally in nanoscience and nanotechnology, according to Shanghai Ranking's Global Ranking of Academic Subjects 2019

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