An eye on the prize

TIANJIN UNIVERSITY'S SCHOOL OF MATERIALS SCIENCE AND ENGINEERING, one of China's earliest, is quickly gaining a new lease of life with exciting research with applications in energy, biomedicine, and manufacturing on all scales.

Tianjin University, which evolved from Peiyang University, China's first modern university established in 1895, launched one of China's earliest and most complete material science programmes in 1985. The university established the School of Materials Science and Engineering (SMSE) in 1997, covering research in metals, ceramics, polymers, functional materials, and welding. Its materials have applications in biomedicine, energy, engineering, manufacturing and many other industries.

Housing six research institutes and several key laboratories, Tianjin University SMSE is rapidly building its strengths. Its material science and engineering programme is now ranked in the global top 0.1%, according to Essential Science Indicators (ESI) subject area ranking. In the four years from 2015 to 2018, the school's research budget reached 370 million RMB, with an annual research budget of about 1 million RMB per person. Faculty members increased from 88 in 2014 to 127 now, including 60 professors and 22 receiving national talent plan support. Researchers have published more than 400 academic papers and received funding for more than 30 national projects per year. The school has also seen successful technology transfers of its research, with 136 granted patents in 2018 alone.

An injectable hydrogel which repairs bone and cartilage in animals, replacement of the vitreous body in a rabbit eye, is just one of the impressive breakthroughs at SMSE. The gel was developed by SMSE's biomaterial scientists, who introduced multiple hydrogen bonds of amino acid into the side chains of polymers to produce supramolecular polymer hydrogel. By controlling the concentration of hydrogen bonds, they produced a reversible gel with a range of mechanical properties, from high strength, robust hydrogels, to soft, injectable self-dissolving ones. Their simple new method has also been used in in-situ breast cancer treatment and post-operation reconstruction.

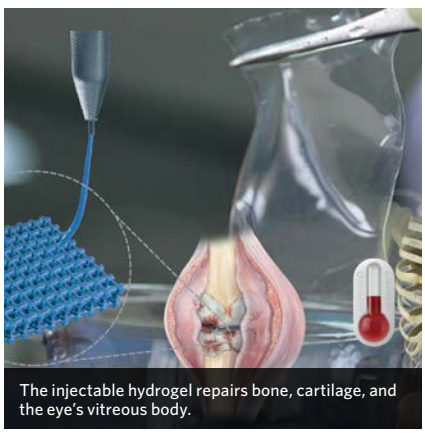
Another example is SMSE's work on metal matrix composites (MMCs), which are widely used in aviation, space, electronics and the automobile industry. A stumbling block in their development is that, while use of a particulate or fibre increases the strength, it often degrades the toughness of the MMCs. SMSE scientists have created a new, three-dimensional reinforcement with graphene architecture for MMCs, using a combination of chemical vapour deposition and powder metallurgy techniques. Their technology will lead to next-generation, strong and tough MMCs.

At SMSE's Institute of Welding and Advanced Manufacturing Technology, researchers are working on cutting-edge technologies with great lucrative potential. Their projects include third-generation high-density semiconductor package process, underwater welding repair of pipelines, and bolstering the structural integrity of large engineering structures. These technologies are vital for China's major development effort in offshore oil and gas exploration, ultra-supercritical electric power plants, and building of tunnel shield machine systems.

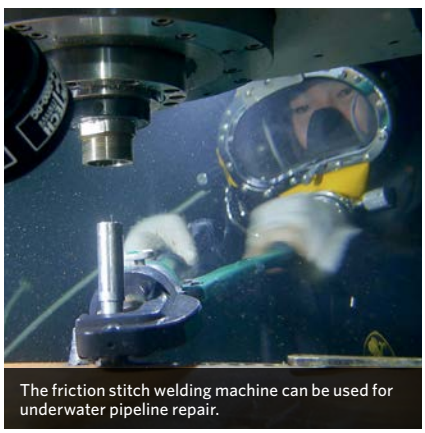
In education, SMSE initiated an honours degree plan named after the renowned Chinese material scientist, Shi Changxu. This novel mentoring programme allows undergraduates to select mentors and courses based on their interests, to encourage personalised training that suits students' capabilities, enhancing their all-round skills and seeking excellence. SMSE is also home to the National Experimental Teaching Demonstration Center for material science and engineering. ■

+86 (0)22 85356663
mseic@tju.edu.cn
mse.tju.edu.cn

Tianjin University SMSE is equipped with a spherical aberration corrected transmission electron microscope integral to its nanomaterials research.



The injectable hydrogel repairs bone, cartilage, and the eye's vitreous body.



The friction stitch welding machine can be used for underwater pipeline repair.

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