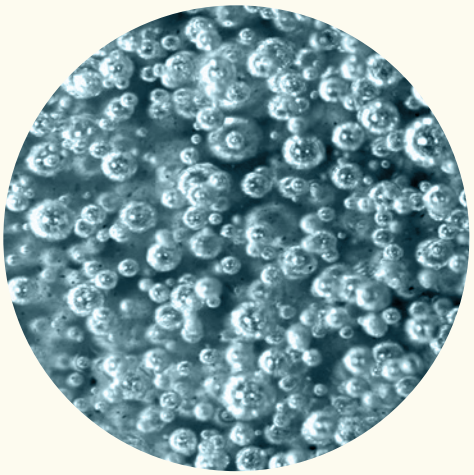
BOTTLING TECHNOLOGICAL BRILLIANCE

Chemical research results are being turned into energy-saving technologies, yielding profits.



The MIRT developed by Zhibing Zhang has enabled large-scale production of micrometre-sized bubbles, improving the efficiency of reactions.

Chemical reactions are the driving force of many industries, ranging from oil refining, to drug development, and wastewater treatment. Technologies developed at the School of Chemistry and Chemical Engineering (SCCE) at Nanjing University (NJU) to speed up reaction processes have improved production efficiency, and yielded greater profits.

The Micro-interface Intensified Reaction Technology (MIRT), developed by SCCE professor, Zhibing Zhang, is a good illustration of how inventions by applied chemists at SCCE benefit society and industry. "We are devoted to advancing fundamental studies, as well as creating social good, by promoting green chemistry and energy-conserving technologies," said Shuhua Li, SCCE dean.

In oil refining, catalytic hydrogenation of residual oil is conventionally performed in slurry-bed reactors under high pressures (16–25 MPa), demanding huge equipment investment, excessive energy consumption, and grave safety risks for industrial scale production. Zhang's team developed the MIRT that significantly increases reaction rates, achieving effective hydrogenation of residue oil in million-ton scale at low or ultra-low pressure (4–6 MPa). This reduces the use of energy and raw materials by more than 10%, with about 20% fewer CO_2 emissions. MIRT is also applicable in a wide range of heterogeneous reaction systems, including alkylation and carbonylation reactions, and wastewater treatments. It has brought huge output growth to collaborating chemical engineering companies.

SCCE researcher, Weiping Ding, focuses on meso-scale catalysts to speed up reactions. Following the working principle of enzymes, his group has developed high-performance catalysts for industrially significant reactions, including selective oxidation and hydrogenation, and low-platinum catalysts for fuel cells.

Another energy-saving technology developed at SCCE enables more efficient polymer processing, the second largest energy-intensive industry in material processing after metallurgy. Plastic polymers are normally processed at elevated temperature when they begin to flow. For instance, polyethylene terephthalate (PET) is blow-moulded into containers, such as beverage bottles, using infrared heating. However, PET barely absorbs infrared light, limiting heating efficiency.

A research group, led by Gi Xue and Dongshan Zhou, designed a hollow, highly infrared-absorbing micro-particle that can firmly adhere to PET polymer chains after proper modification of particle hydrophilicity. Adding only a small amount of these particles into PET can significantly increase the heating efficiency, reducing energy consumption by 25%, and shortening processing time by 26%.

With certification from the FDA for beverage packaging, this energy-saving PET is already used by multinational companies like Coca Cola and Pepsi. Given the huge number of PET bottles processed annually, broad use of this novel PET will lead to significant power saving and reduction in global carbon dioxide emission.

Technologies developed by SCCE researchers have also been used in the electronics industry. A research team led by Xiangzhen Sun and Yi Pan has developed a series of highly pure organometallics, which are compounds with a direct bond between carbon and a metallic or metalloid element. With almost 100% purity, their compounds are widely used as electronic chemicals in semiconductors.

Jiangsu Nata Opto-electronic Material Co., Ltd., a spin-off of NJU, owns the intellectual property for the technology, and realized large-scale production of high-purity electronic materials. The enterprise has become one of the world's major suppliers of metal-organic compounds. ■

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