Energizing research on all fronts

INTERDISCIPLINARY INVESTIGATIONS ON ENERGY AND MATERIALS are a strong focus at ShanghaiTech University.

In a report released in 2018 by the UN Intergovernmental Panel on Climate Change (IPCC), scientists warned that the most catastrophic effects of climate change could be fully realized as early as 2040, given the current rate of global warming. Their reminder of the need to substantially reducing CO_2 emissions is echoed by researchers at ShanghaiTech University, a small research university jointly established by Shanghai Municipal Government and the Chinese Academy of Sciences.

Reducing greenhouse gas emissions from fossil fuel combustions is critical for slowing global warming, and chemical fixation of CO_2 is an effective strategy. This involves chemical reactions to convert inorganic carbon in CO_2 to organic compounds. Focusing on electrochemical reductions of CO_2, Bolin Lin, from ShanghaiTech's School of Physical Science and Technology (SPST), and colleagues, developed a theoretical framework to describe relationships between energy and CO_2 arising from fossil fuel combustion. They demonstrated the potential of fossil fuels to drive electrochemical fixation of CO_2 and reduce emissions.

From energy and materials, to synthesis and catalysis, teams at SPST are dedicated to interdisciplinary studies that contribute to the development of new energy sources and bring environmental benefits. Particularly, featuring an integration of chemistry, materials science, mechanical and electronic engineering, its Division of Systems Materials seeks to integrate fundamental material discoveries into a mission to address the world's biggest challenges.

A significant breakthrough also comes from new porous materials for methane storage with ultra-high capacity, developed by Yuebiao Zhang's group. By synthesizing new zinc metal-organic frameworks, studying their crystal structures and methane adsorption properties, the team has identified compounds of exceptionally high deliverable capacities, surpassing the target set by the US Department of Energy, and previously reported records achieved by other materials. The discovery points to potential improvements to the design and manufacturing of vehicles powered by natural gas.

Another SPST researcher, Zhijun Ning, developed an efficient and stable perovskite solar cell. The NiOx-based perovskite solar cell has an inverted structure, which helps harness high-energy photons. To improve rigidity and performance, Ning's team introduced a secondary amine, dimethylamine, to the structure to reduce defect density and enhance hydrophobicity. The resulting solar cell achieved a power conversion efficiency of 20.8%, the highest reported of its kind, along with record-high stability.

The division also focuses on an assembly of devices for particular composite functions, including a hydrogen energy system consisting of units for hydrogen production, transport, storage, and use. It plans to further develop research on low-carbon energy, and material research driven by big data, which show great potential. ■

SPST in glance

As one of the five schools of ShanghaiTech, SPST features:

- **Four** research divisions on systems materials, condensed matter physics and photon science, materials and physical biology, and big science research and development
- **Three** research platforms: Center for Characterization and Analysis, Center for High-resolution Electron Microscopy, Soft Matter Nanofabrication Laboratory

It seeks applicants for multiple tenure-track and tenured positions at all ranks.

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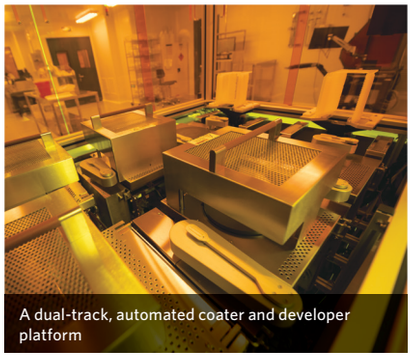
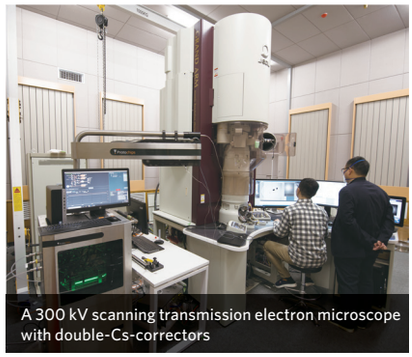
A scanning helium ion microscope, using ion beam techniques


A dual-track, automated coater and developer platform


A 300 kV scanning transmission electron microscope with double-Cs-correctors