Tamkang University Research Team Led by Wei-Chi Lai Develops Safer and Greener Next-Generation Lithium Battery Materials, Featured on the Cover of a Leading International Journal

Campus focus

A research team led by Professor Wei-Chi Lai from the Department of Chemical and Materials Engineering at Tamkang University has recently achieved a breakthrough in battery materials research. Their innovative work, which offers a promising new direction for the development of environmentally friendly next-generation batteries, has been featured on the cover of Green Chemistry, a leading journal in sustainable and green chemistry published by the Royal Society of Chemistry. With a five-year impact factor of approximately 9.8, the journal is ranked among the top Q1 journals in chemistry and green engineering, and cover articles are selected from particularly impactful studies.

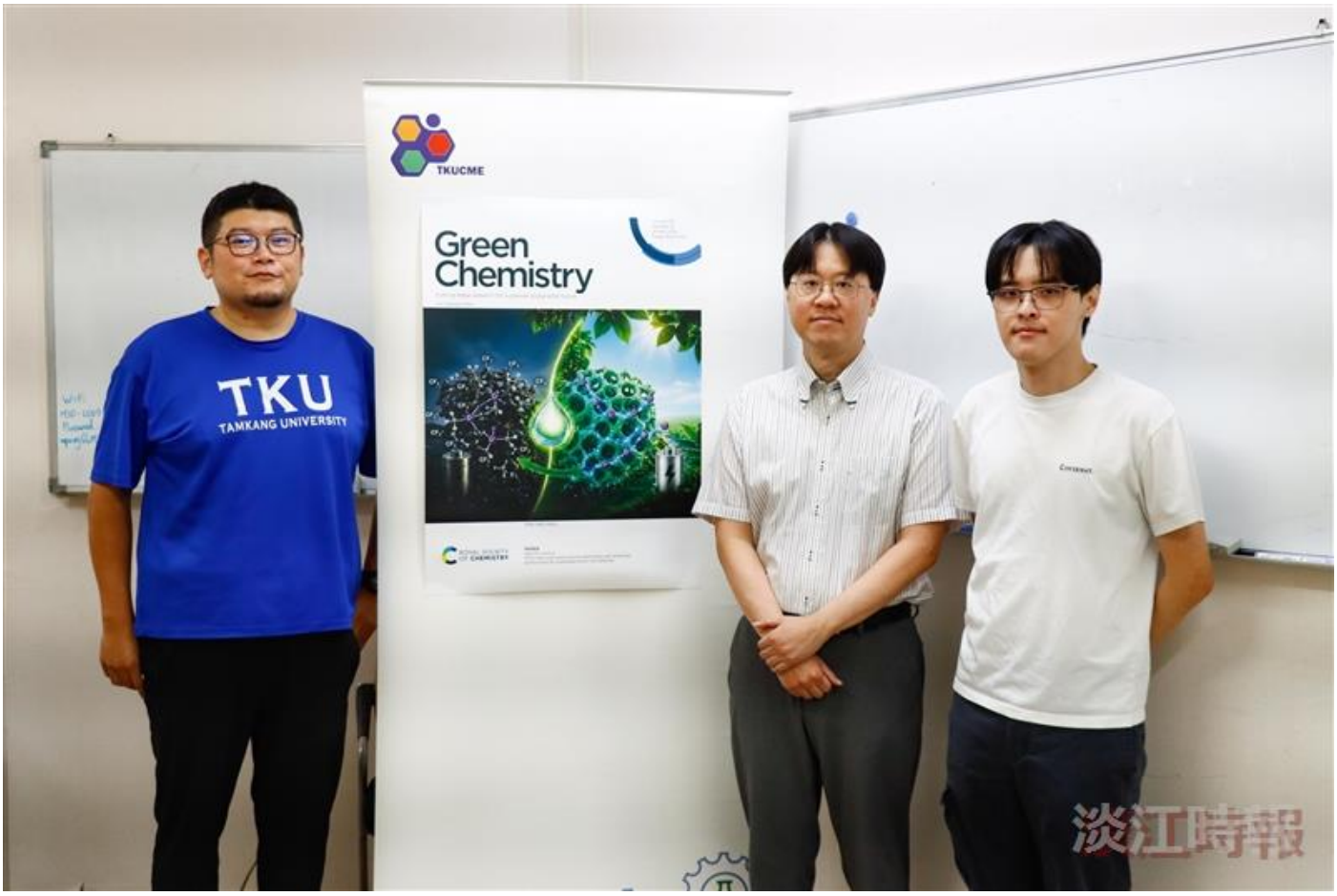
Traditional batteries rely on liquid electrolytes, which can leak and pose fire safety risks. To address these challenges, researchers worldwide have been developing next-generation lithium batteries, with quasi-solid-state electrolytes emerging as a key enabling technology. However, the production of these gel-like electrolytes has traditionally depended on fluorinated polymers and solvents. These fluorinated substances, known collectively as PFAS (per- and polyfluoroalkyl substances), are often referred to as “forever chemicals” because they are extremely difficult to degrade in the environment, leading to long-term pollution concerns that are increasingly subject to regulatory restrictions around the world.

To address this environmental challenge, Prof. Lai, doctoral student Shen-Jhen Tseng, and master’s student Li-Eng Chen successfully developed a PFAS-free electrolyte. Instead of using conventional fluorinated materials, the team adopted polyethersulfone (PES), a fluorine-free polymer commonly used in water purification membranes. PES offers excellent thermal stability, mechanical strength, environmental advantages, and strong commercial potential.

Because PES alone does not provide sufficient ionic conductivity, the researchers incorporated polyethylene oxide (PEO) into the material. Acting like a “highway” for lithium-ion transport, PEO enables lithium ions to move more efficiently through the electrolyte while also enhancing flexibility and electrolyte absorption. Furthermore, the fabrication process employs low-pollution, environmentally friendly solvents, aligning closely with the principles of green chemistry. This commitment to sustainable materials and manufacturing was a key factor behind the study’s selection as a journal cover feature.

Wei-Chi Lai noted that his laboratory has long been dedicated to research in green polymers and sustainable energy materials. Current research areas include electrochemical energy storage, hydrogen energy systems, and carbon dioxide capture technologies. Through innovations in materials science and environmentally responsible manufacturing processes, the team aims to advance low-carbon and sustainable technologies. The research group also places strong emphasis on student training and hands-on research experience. Students are encouraged to participate directly in international journal publications, materials development projects, and interdisciplinary collaborations, thereby strengthening both their research capabilities and global perspectives.

In addition to receiving support from the National Science and Technology Council, the project was funded for an international collaborative research visit to Oregon State University. The team also expressed special gratitude to distinguished alumnus Wen-Chen Chien, professor and dean of the College of Environment Resources and the Talent and Technology Cultivation base for Energy Battery Industry at Ming Chi University of Technology, for providing research facilities, equipment, and technical support that contributed significantly to the successful completion of the project.


TKUCME
Green Chemistry
TKU
TAMKANG UNIVERSITY
淡江時報


Green
Chemistry
淡江時報