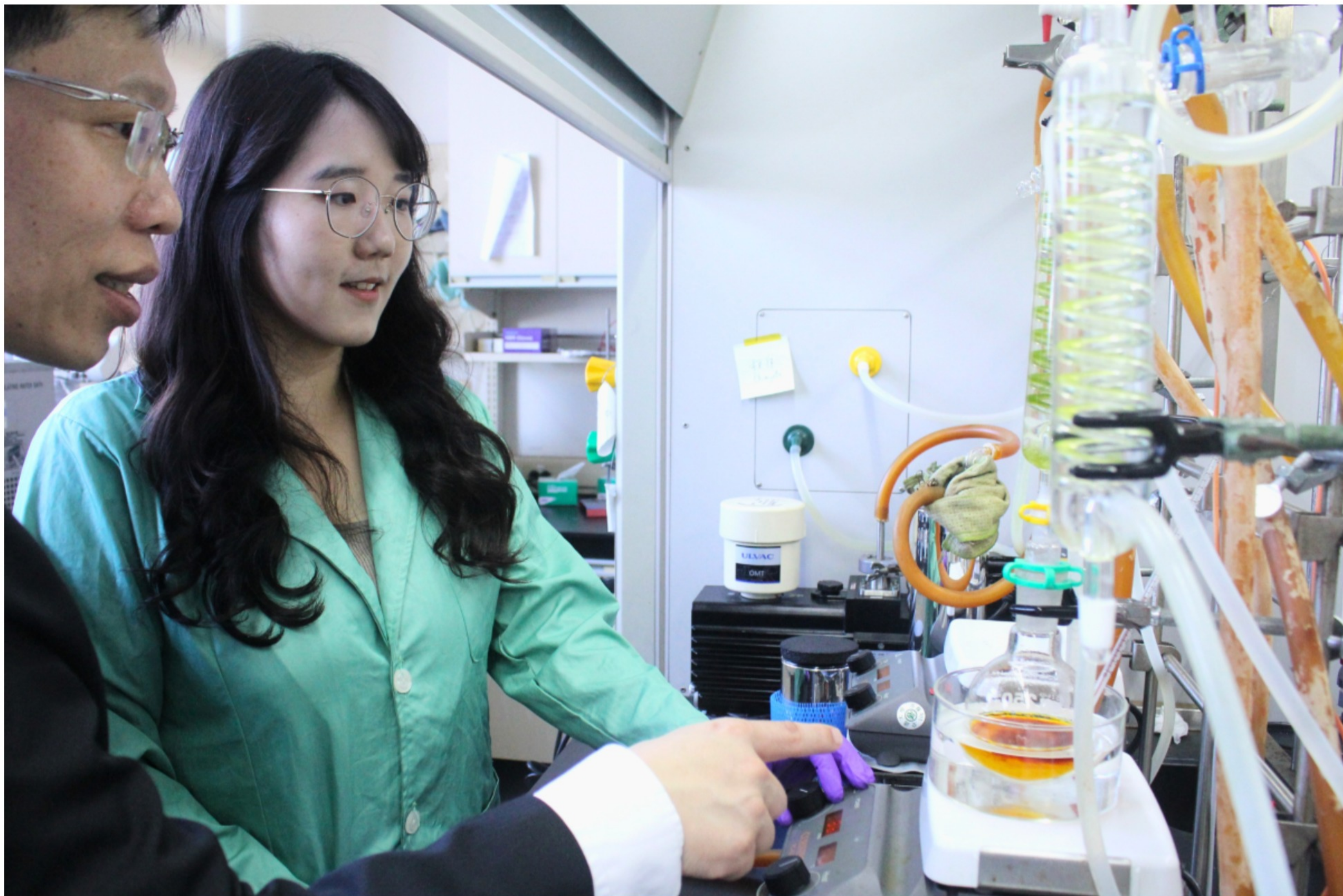


NEWS

Research Highlights

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NYCU and German Team Develop Light-Activated Nanopores for Smart Materials and Security Tech

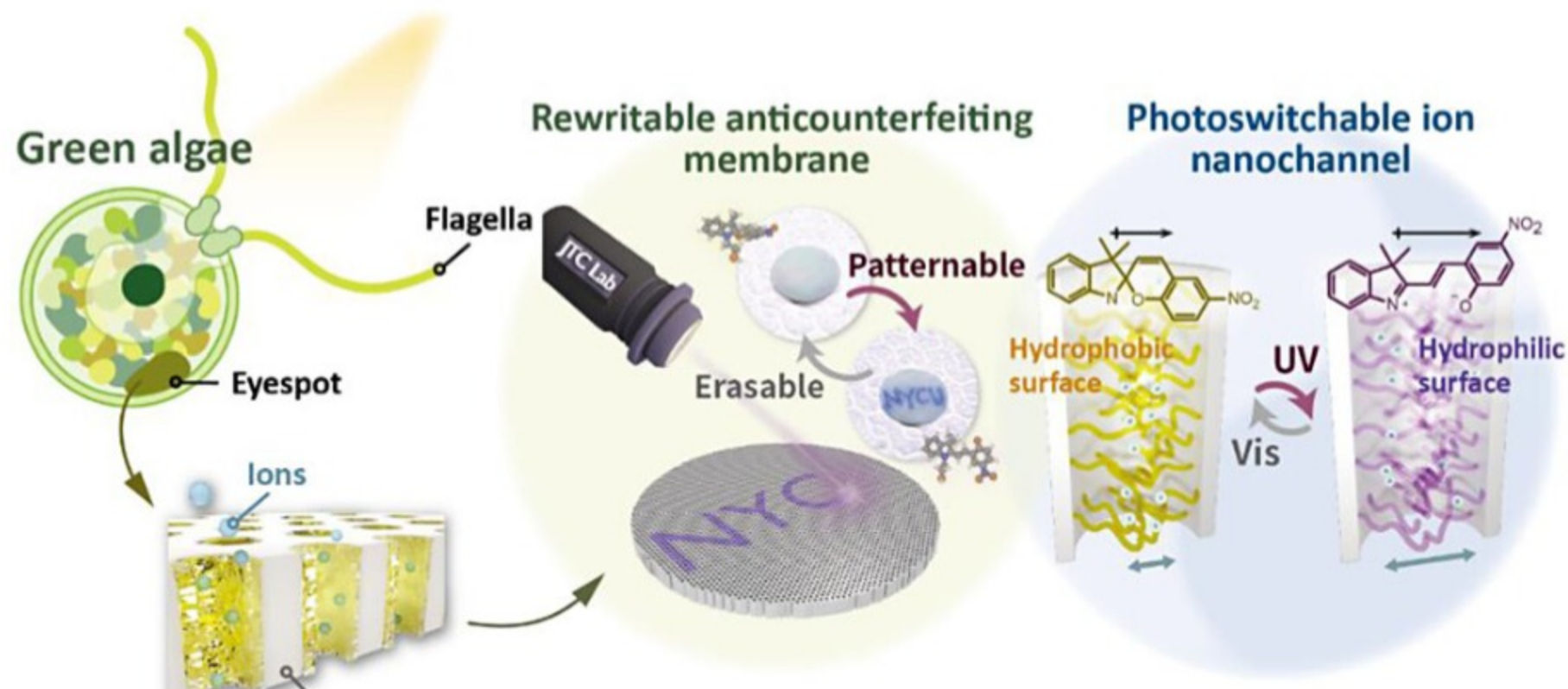


Professor Jiun-Tai Chen (left) and his Ph.D. student Yi-Fan Chen.

Edited by Chance Lai

Imagine flipping a molecular switch using nothing but light. A groundbreaking study led by Professor Jiun-Tai Chen from the Department of Applied Chemistry at National Yang Ming Chiao Tung University (NYCU), in collaboration with Professor Patrick Théato from the Karlsruhe Institute of Technology (KIT) in Germany, has unveiled a novel class of “light-responsive nanopores.”

Titled “[Illuminating Biomimetic Nanochannels: Unveiling Macroscopic Anticounterfeiting and Photoswitchable Ion Conductivity via Polymer Tailoring](#)”, the research was published in the prestigious journal ACS Nano and opens exciting possibilities for future smart materials and anti-counterfeiting applications.



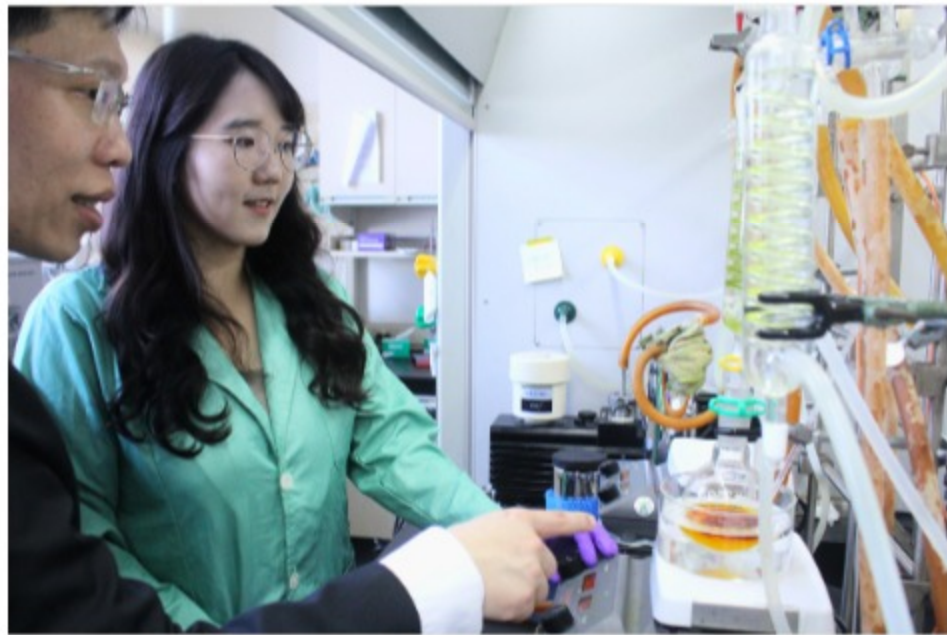
Inspired by green algae, NYCU researchers created light-responsive nanopores that switch between hydrophobic and hydrophilic states, enabling rewritable anti-counterfeiting surfaces and controlled ion transport.

Nature-Inspired Innovation: Lessons from Algae

The inspiration came from an unlikely source: algae. In aquatic environments, algae navigate toward light to optimize photosynthesis, guided by light-sensitive ion channels known as channelrhodopsins (ChRs) embedded in their cell membranes. These channels enable algae to regulate ion flow based on light cues, maintaining physiological balance in changing environments.

Mimicking this natural mechanism, the research team engineered nanoporous structures from anodic aluminum oxide (AAO), then coated the pores with a light-responsive polymer made of spiropyran—a molecule that changes structure when exposed to light. The result: a synthetic nanopore system that can open or close in response to UV light, effectively functioning as a controllable ion gate.

Related Image(s) :



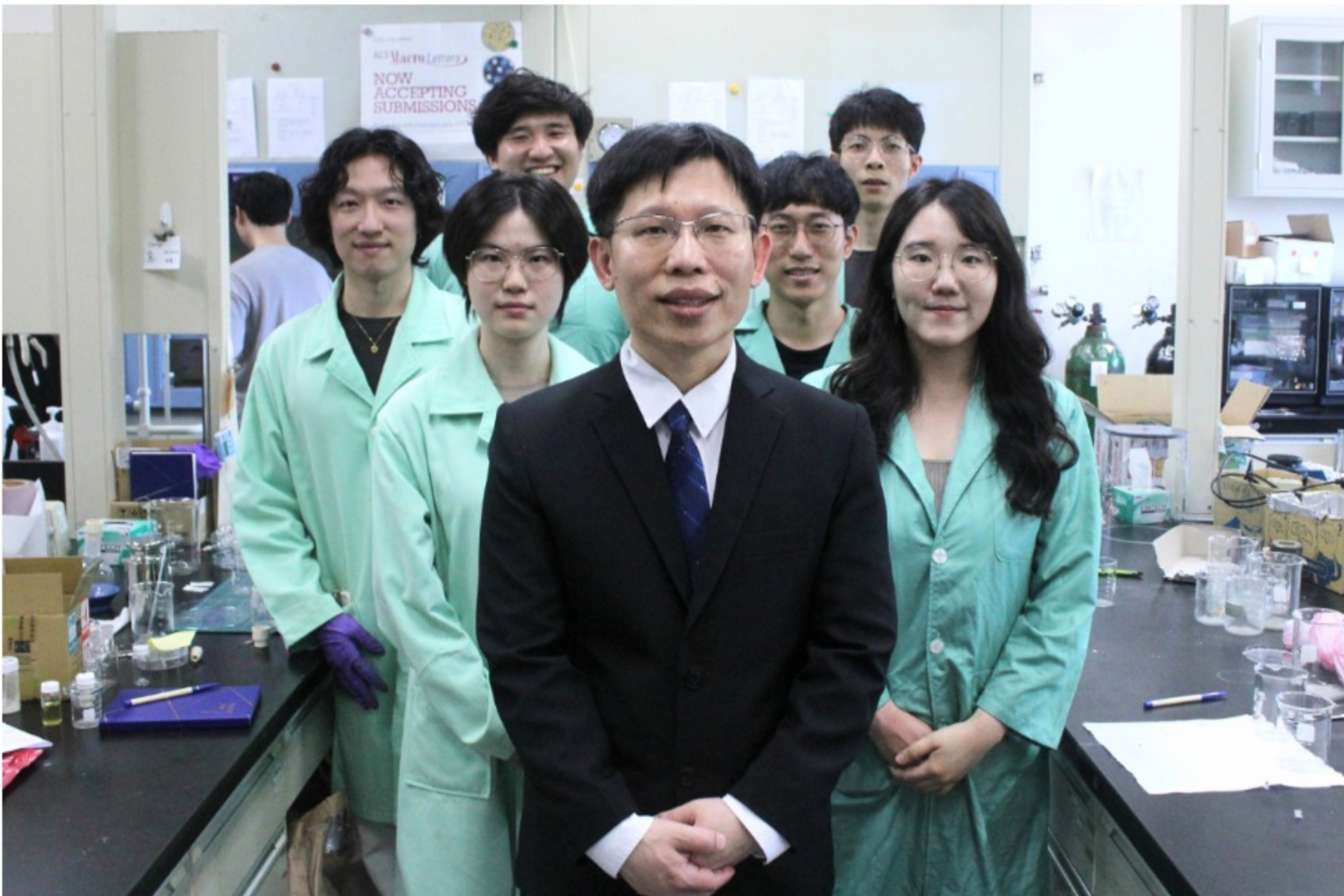
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A Light Switch at the Nanoscale

“The key lies in spiropyran’s molecular transformation,” explained Professor Chen. “When exposed to ultraviolet light, the molecule shifts from a closed, non-polar form to an open, charged form. This alters the nanopore’s hydrophilicity and drastically impacts ion transport.” Accompanying this transformation is a visible color change from clear to deep violet, hinting at applications in optical anti-counterfeiting labels where authentication could be done with the naked eye.

Toward a Sustainable Smart Future

Beyond security features, this light-gated nanopore technology holds promise for cutting-edge uses in drug delivery, optical data storage, and biomedical engineering. The findings mark a significant step forward in both materials science and biomimetic design. In the near future, a single beam of light may be all it takes to unlock the full potential of smart materials—one photon at a time.



Professor Jiun-Tai Chen and his research team.

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