07 AFFORDABLE AND CLEAN ENERGY

Ensure access to affordable, reliable, sustainable and modern energy for all.

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1240

Publications in SCOPUS

34

Course units

10.3%

Percentage of all Taiwan publications

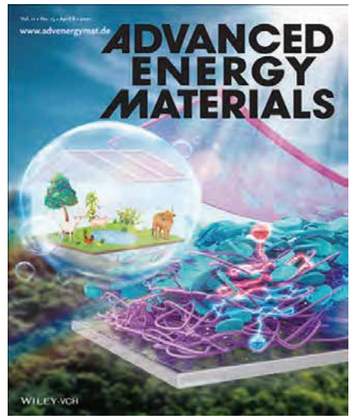
8153

Students who chose the course units

Research

Breakthroughs in Semi-Transparent Organic Photovoltaics' Efficiency

The research team led by Professor Kung-Hwa Wei of the NYCU Department of Materials Science and Engineering has extensive experience in the field of semi-transparent organic photovoltaics research. The team recently applied the novel method of continuous coating to their semi-transparent organic photovoltaics to achieve a p-i-n active layer structure. Thanks to this, when increasing the visible light transmission of a component, its high photoelectric conversion efficiency is maintained. This makes the semi-transparent organic photovoltaics prepared by the team the most efficient organic solar cells in terms of photoelectric conversion. Furthermore, the team's research results have been published in the internationally renowned scientific journal *Advanced Energy Materials*. The research has helped Taiwan achieve world-class standards with respect to semi-transparent organic photovoltaics technology, demonstrating Taiwan's capability to develop this technology independently. Currently, the team is actively conducting research on how to apply this technology in smart greenhouses.



Cover article of the journal

Diagram of the cross-sectional molecular structure of the p-i-n active layer of the semi-transparent organic photovoltaics. The blue disc and purple line represent p-type macromolecules and n-type small molecules, respectively.

Cheng Wang, Pei Cheng, Shaun Tan, Chung-Hao Chen, Bin Chang, Cheng-Si Tsao, Li-Yin Chen, Chung-An Hsieh, Yu-Che Lin, Hao-Wen Cheng, Yang Yang, Kung-Hwa Wei. Sequential Deposition of Donor and Acceptor Provides High-Performance Semitransparent Organic Photovoltaics Having a Pseudo p–i–n Active Layer Structure. Advanced Energy Materials, 2021, 11, 2003576. Copyright Wiley-VCH GmbH. Reproduced with permission.

Exploring the Distinct Carrier Transport Properties of Halide Perovskite Heterostructures

Halide perovskites have been extensively applied to solar cells and optoelectronic devices. In particular, aligning 2D/3D perovskite heterostructures is a strategy applied to improve stability and conversion efficiency, but such heterostructures often lack clear interfaces and chemical compositions, which is why there is a lack of systematic research on the photophysical properties of 2D/3D halide perovskite heterostructures. The research team of Professor Yung-Jung Hsu of the Department of Materials Science and Engineering collaborated with the research team of the University of Wisconsin-Madison to successfully align 2D/3D halide perovskite heterostructures, using time-resolved spectrometers to analyze the carrier transport kinetic model of this material. The results were conducive to the development of photoelectric conversion applications. Furthermore, the research results were published in the internationally renowned *Journal of the American Chemistry Society*.

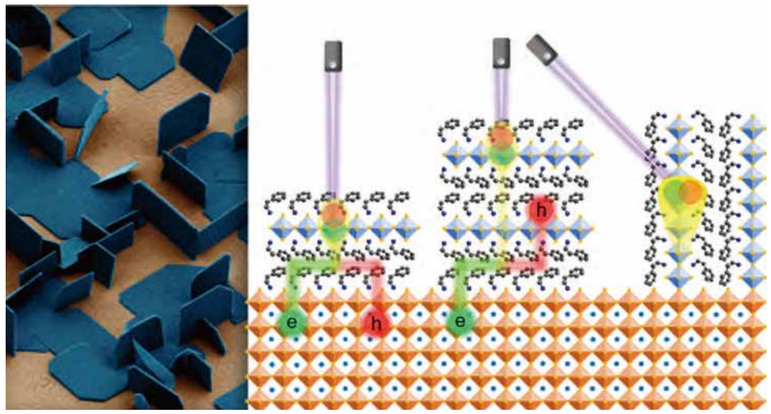


Diagram of the microstructure image and carrier transport kinetic model of 2D/3D perovskite heterostructures.

Ming-Yu Kuo, Natalia Spitha, Matthew P. Hautzinger, Pei-Lun Hsieh, Jing Li, Dongxu Pan, Yuzhou Zhao, Lih-Juann Chen, Michael H. Huang, Song Jin, Yung-Jung Hsu, John C. Wright. Distinct Carrier Transport Properties Across Horizontally vs Vertically Oriented Heterostructures of 2D/3D Perovskites. Journal of the American Chemical Society, 2021, 143, 4969. Copyright American Chemical Society. Reproduced with permission.

The Era of Electric Vehicles is Coming - Promoting Sustainable Development with Green Energy

In recent years, the world has become increasingly aware of the importance of conserving energy and reducing carbon emissions. In the face of energy shortages, reducing greenhouse gas emissions has become an important sustainable development strategy for countries around the world. Many countries have proposed green energy policies to ban the sale of traditional fuel vehicles, which are to be replaced with electric vehicles, resulting in a substantial increase in the demand for EV batteries. To ease the rapidly increasing demand for batteries in the market, Professor Wei-Hua Chieng and his research team from the NYCU Department of Mechanical Engineering developed fast-charging batteries for electric vehicles with highly efficient charging/discharging rates, high safety levels, and long cycle lives.

Social Impact

Japan-Taiwan "Tokyo Tech" NYCU Joint Online Workshop

In 2021, the NYCU College of Engineering and Japan's Tokyo Institute of Technology jointly organized the 2021 Japan–Taiwan “Tokyo Tech” NYCU Joint Online Workshop. Representatives from NYCU’s College of Engineering, Renewable Energy Technology Development Research Centers in Taiwan, Japan, and South Korea, the Tokyo Institute of Technology, and Taiwan’s Ministry of Science and Technology officials in Japan were all invited to take part in the online workshop. Research topics such as green energy technology development and energy optoelectronic materials were discussed in the workshop, and its focus was the use of optoelectronic materials for energy conversion applications to implement renewable energy development. The participants shared their experiences through discussions, invigorating the development of new forms of green energy technology.

Taipower D/S One: The Beauty of Infinity

“Taipower D/S One” is Taiwan’s first green energy exhibition center representing Taiwan Power Company’s “Green, Smart, and the Future” brand image. The exhibition center is headed by Professor Shu-Chang Kung of NYCU’s Graduate Institute of Architecture. Professor Kung was the advisor for NYCU’s Orchid House team at the 2014 European Solar Decathlon, where the team won an award. In the two years since its opening, Taipower D/S One has received multiple international awards, including the MUSE Award of the American Alliance of Museums. The first floor of the exhibition center features a “VR six-axis robot,” which allows visitors to experience the evolution of sustainable energy from microorganisms to solar, wind, and ocean energy. The second floor includes an energy gym called “Energym,” turning solar energy, wind energy, and water power into various interactive fitness facilities. In addition to experiencing different fitness games, visitors can also learn about how different energy sources in Taiwan operate. Taipower D/S One demonstrates the limitlessness of energy, becoming a platform for green energy sustainability.

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Student Cultivation

GMBA Student Team Wins First Place at the CTCI Youth Sustainability Innovation Program

NYCU's GMBA student team "VIV TEAM" participated in the first CTCI Youth Sustainability Innovation Program in 2021, winning first place among 82 teams. NYCU's GMBA program has always emphasized education on entrepreneurship and innovation. For its core course of "Startup Business Planning," team members Ya-Ching Chang and Chia-Yun Lu from the College of Management, along with Huan-Ting Huang and Cheng-Kai Ko, cooperated with Hsin-Yi Li from the Department of Mechanical Engineering to propose a "carbon neutral" solution based on wind energy. They integrated the concept of sustainability within their proposal and applied the commercialization skills they learned in class, which led them to win the award.

Energy System Design and Application Course

NYCU offers the course "Energy System Design and Application" to facilitate students' understanding of the characteristics of different energy sources and relevant concepts that affect energy systems. The course starts with the basic concepts of energy, then looks at the characteristics and requirements of energy systems from the perspective of energy balance; subsequently, the course goes into energy demand issues by discussing the three main sources of energy consumption in Taiwan, namely buildings, air conditioning, and lighting. Finally, from a management perspective, the course looks at the development of energy management systems and smart grids through the lens of Taiwan's power structure, discussing how to achieve a better energy usage model with minimal carbon emissions. The course also includes hands-on practice in designing energy systems, to strengthen students' understanding of energy construction concepts, system considerations, and analytical methods.

Stewardship

Educating Elementary School Students About Energy

The Transdisciplinary Design Innovation Shop organized the "Sustainable Building Education Workshop: Green Energy Buddies on a Mission" to teach the concept of renewable energy to students starting from elementary school. Students from Jian Gong Primary School were invited to visit the "TSMC × NCTU Energy Education Center." The center is an upgraded version of the "Orchid House" design that won various awards at the 2014 European Solar Decathlon. The workshop began with a series of questions and answers designed to show kids that protecting the land, human development, energy conservation, and smart living are not mutually exclusive. Then, the children were invited to observe instances of energy consumption in everyday life. They learned about the power consumption levels of lamps, air conditioning, computers, and other home appliances, converting the amounts into electricity fees. The event taught these children that "energy may be used up one day" so that they could understand the importance of energy conservation and how renewable energy and urban energy transformation are not only imperative but also feasible. Finally, they were divided into five groups to discuss creative solar photovoltaic applications, drawing their ideas on posters. The creative ideas they came up with were full of possibilities outside of grownups' imagination, such as a flying car that could bypass rush-hour traffic, a solar-powered time-travel watch, a solar-powered kitty car with a TV installed, a solar-powered house that could attack enemies and defend residents of an alien planet, and an all-purpose flying house that could fly people to, among other locations, their grandma's house.