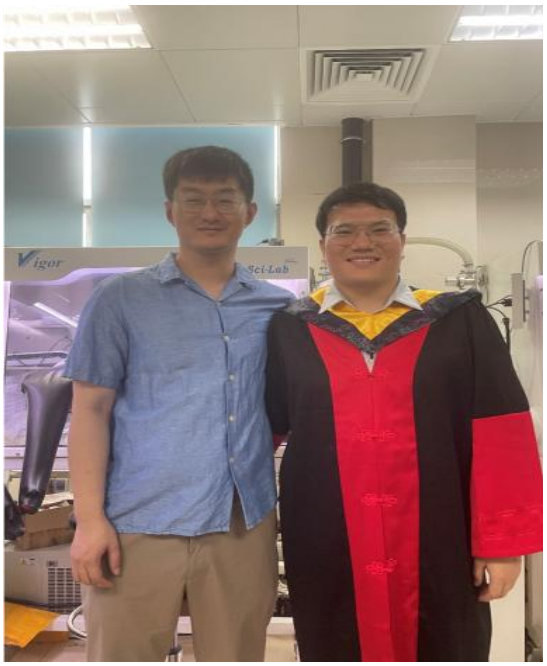
Brothers Born in 1997 to Publish the First Science in School History: a World Record!

East China University of Science and Technology (ECUST) recently welcomed the first Science paper in the university's history.

The team of the university's professors Wu Yongzhen and Zhu Weihong, together with their collaborators, achieved the latest results in the field of organic hole transport materials for chalcogenide solar cells. The solar cell they obtained based on this technology has a power conversion efficiency of 25.4%, setting a world record. The two co-authors of the paper were born in 1997, and they are two doctoral siblings--Zhang Shuo and Ye Fangyuan.

Not long ago, Ye Fangyuan successfully graduated from East China University of Science and Technology after completing a five-year master's degree program. Although Fangyuan Ye has already published six papers as an author or co-author in journals such as Nature and Solar RRl since 2021, he was still "very excited" when he heard that the paper would be published in Science.

This paper focuses on a hot area: chalcogenide solar cells. Chalcogenide cells belong to the third generation of solar cells, which have four major advantages: high efficiency limit, low cost, stackable and flexible, and are seen as a revolutionary new material with high expectations from the industry.



ZhangShuo and Ye Fangyuan

"But the so-called 'high power generation efficiency' of chalcogenide batteries, to a large extent, remains in theory. The actual power generation efficiency of current chalcogenide cells has actually not reached the level of traditional PV silicon wafers."

Ye Fangyuan explained to China Science Daily. And what they want to do is to make that efficiency even, even higher. The structure of a chalcogenide battery is like a sandwich, with the chalcogenide material covered with electron-transporting and hole-transporting materials on each side.

Ye Fangyuan, 26 years old, has been studying in East China University of Science and Technology since his undergraduate year. In his opinion, chemistry and chemical engineering have always been the dominant discipline of HuALI. Fortunately, he met Professor Wu Yongzhen, who was very helpful to him.

The so-called hole-transporting material is an organic semiconductor material that can achieve controlled migration of carriers in a directional order under the action of an electric field, thus achieving the role of transporting electric charge.

However, conventional hole-transport materials are either too hydrophobic to wet the chalcogenide precursor or react with chalcogenide, leading to performance-limiting defects at the buried interface between layers.

In this study, the team innovatively introduced the cyanophosphonic acid unit to develop an amphiphilic small molecule hole transport material, and constructed an ordered, ultrathin, surface superimpregnated layer through dynamic self-assembly, which solved the two major problems of carrier transport and interface defect control in device applications.

It is worth noting that the team's trans-structured chalcogenide solar cells, prepared based on organic hole transport materials. It has been certified by a third-party organization to have an efficiency of 25.4%, which creates the highest conversion efficiency of this type of solar cell at present.

In addition, the new organic hole transport material has good wettability, which is very conducive to the preparation of large-area devices. It is not only applicable to chalcogenide cells, but also can be used in organic polymer solar cells with good versatility. At present, this technology has applied for a patent for invention.

In recent years, chalcogenide batteries are hot, not only in the market attention, but also easy to win the favor of some top academic journals. "Calcium titanium ore batteries, if well developed, can be applied to a very rich scene. In addition to doing photovoltaic power plants to generate electricity, they can also be used for indoor photovoltaics, wearable devices and so on. For example, we can install foldable flexible batteries on clothes and backpacks, so we don't need to go out with heavy charging treasure." Ye Fangyuan said, "We do scientific research, to a large extent, I hope to promote the development of human society. To a small extent, I hope to make our lives better, even if only a little. This field of battery meets my expectation."

In January 2021, under the guidance of Prof. Yongzhen Wu, Fangyuan Ye published his first paper in Solar RRl, a journal in the field of solar energy. The study proposed an anchored assembly molecule for bottom interface electron transport material design. This method has been widely used in the design of hole transport materials.

Although this is a "small article", it has a deep impact on Ye Fangyuan: "The first time I published a paper, my scientific thinking, scientific research ability and English writing ability have been greatly practiced. But more importantly, this is the first time I have created something that can be applied in real life scenarios through a scientific idea."

Ye Fangyuan and Martin Stolterfoht

In this low-key and pragmatic group, Ye Fangyuan has become deeper and deeper in the field of materials development, but he also realizes that in addition to depth, the breadth of scientific research is also very important. With the support of Prof. Wu Yongzhen, he began to take the initiative to seek opportunities for exchange and study abroad.

Ye Fangyuan looking for foreign mentors is also very unique thinking - by reading a large number of literature for "sea selection".

"Because calcium titanium ore solar cells is an emerging hot field," Ye Fangyuan said, "this field will have a large number of papers published every month, but which articles have 'dry goods', which articles are 'watering', we are still very clear." Following the clues of the papers, Ye Fangyuan found Dieter Neher's e-mail address and sent an e-mail.

He first introduced himself and his work, and put forward his views on Dieter Neher's paper, while expressing his desire to go to exchange and study.

Soon after, Dieter Neher wrote back inviting him for an interview. After the interview, Ye Fangyuan applied for the State Scholarship and went to Germany to conduct research.

In Germany, Dieter Neher arranged Martin Stolterfoht, a young PI, to supervise Ye Fangyuan, and the two of them became the last ones to leave the lab. One night after work, Martin Stolterfoht came over with several bottles of beer and asked Ye Fangyuan if he could have a drink. I didn't realize that Ye Fangyuan had the same taste, and since then the two of them often had a drink after work, chatting about scientific research, interests, life, and hobbies. During that time, Ye Fangyuan felt very rewarding, like opening a new perspective.