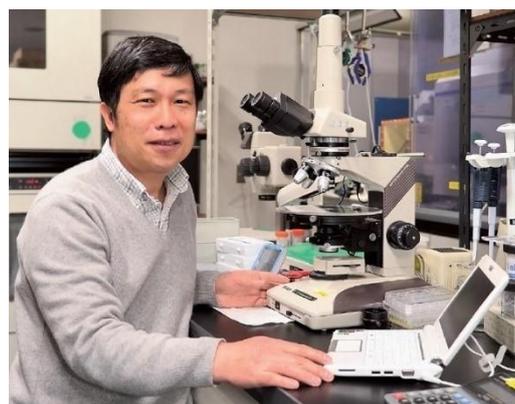


## ■ Feature

### Okayama University excels in research on photosynthesis Jian-Rena Shen and colleagues open up a bright future on artificial photosynthesis

Plants and various algae use sunlight to convert carbon dioxide and water into carbohydrates and oxygen, thus providing the source of foods and oxygen for sustaining almost all life forms on the earth. Needless to say, school children learn about this process of “photosynthesis”, but intriguingly, some of the detailed mechanisms of photosynthesis are still not well understood. Revealing the mechanisms of photosynthesis will not only have a huge scientific impact, but may also provide insights for the development of artificial photosynthetic systems which may contribute to mitigating the world’s energy and environmental problems. Ultimately, such developments may change the daily lives of all the people in the world. With this background, there is increasing worldwide interests in demystifying the mechanisms underlying photosynthesis.

At Okayama University, a wide variety of cutting-edge research projects are underway, and one of the university’s strengths is research on plants. Notably, Professor Jian-Ren Shen, Vice Dean of the Research Institute for Interdisciplinary Science, Okayama University, is one of the world’s pioneers in the field of photosynthesis research. He and his group has solved the atomic structure of photosystem II, a huge membrane-protein complex catalyzing the light-induced water-splitting reaction, based on which, the mechanism of water-splitting and oxygen-evolving reaction was revealed. To recognize his achievements, Professor Shen was awarded the Gregori Aminoff Prize for 2020 by the Royal Swedish Academy of Sciences.



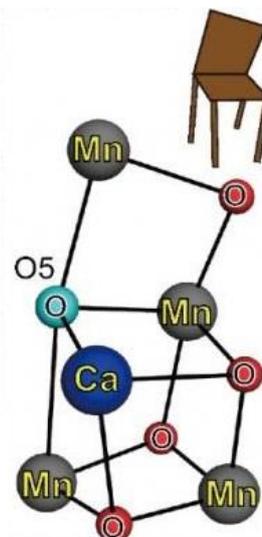
Professor Jian-Ren Shen

The Gregori Aminoff Prize is awarded annually to recognize researchers who have accomplished notable achievements in crystallography. Professor Shen was awarded the Prize jointly with Professor Douglas Rees of the California Institute of Technology for “their fundamental contributions to the understanding of biological redox metal clusters”.

In 2009, Professor Shen’s team succeeded for the first time in obtaining a well-ordered, high quality crystal of photosystem II. This enabled analysis of the long-unknown atomic structure of photosystem II. His

achievement was published in the journal *Nature* in 2011, and was also selected as one of the Top 10 Scientific Achievements of 2011 by the *Science* magazine. Since then, Professor Shen's group continued to study the mechanism of photosynthetic water-splitting by solving the intermediate state structures of photosystem II using femtosecond X-ray free electron lasers, and demonstrated the incorporation of water molecules into the Mn<sub>4</sub>CaO<sub>5</sub>-cluster, the catalyst for water-splitting in photosystem II, as well as the formation of oxygen molecules within the catalyst.

Structure of a catalyst contained in photosystem II for splitting water molecules revealed by Professor Jian-Rena Shen and his colleague. The structure looks like a distorted chair.



The structure and mechanism of the natural catalyst for water-splitting provide important clues for the development of artificial catalysts for obtaining hydrogen from water. If artificial photosynthesis were to become a reality, it would be possible to generate hydrogen energy from water and sunlight, and produce ethanol and other organic substances to be used as fuels from carbon dioxide that is the source of global warming. Thus, artificial photosynthesis is drawing much attention from around the world as an extremely important technology towards achieving the U.N. Sustainable Development Goals (SDGs), to which Okayama University is extensively committed,

The awards ceremony and commemorative lecture will take place in the academy's annual meeting on March 30 and 31, 2020 in Stockholm. Professor SHEN commented on receiving the Prize: "It is a great honor to be awarded the Gregori Aminoff Prize. My achievements so far are the results of joint researches with many co-researchers. I would like to express my sincere gratitude to my co-researchers and continue my efforts to obtain even greater research results."

In 2013, Okayama University was selected by the Program for Promoting the Enhancement of Research Universities, designed to support world-leading, excellent research projects, by the Ministry of Education, Culture, Sports, Science and Technology. A wide variety of innovative research projects are underway at the University. As a research university, Okayama will continue to promote innovative research projects and transfer the results of such projects into the society.

### Further information

Professor Shen was awarded Gregori Aminoff Prize  
from Royal Swedish Academy of Sciences  
[http://www.okayama-u.ac.jp/eng/news/index\\_id8822.html](http://www.okayama-u.ac.jp/eng/news/index_id8822.html)



The Royal Swedish Academy of Sciences website  
<https://www.kva.se/en/startside>



“Okayama University supports the Sustainable Development Goals”