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研究課題名	ソーラー燃料の高効率製造に向けた波長帯域の補完的技術の融合
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研究成果の概要

Various artificial photosynthetic technologies, including photocatalysis, photoelectrochemistry and photovoltaic-electrochemical systems, have been developed. However, one significant challenge in these technologies is the limited utilization of the full solar spectrum, leading to low solar-to-chemical conversion efficiency. To overcome this limitation, integrating solar thermal approaches with artificial photosynthetic devices can be a promising solution. This project aims to combine solar thermal approaches with artificial photosynthesis to maximize solar energy utilization for fuel production.

In the past year, we successfully integrated a solar evaporation generator with photocatalytic systems to achieve light-driven overall water splitting and CO_2 reduction reactions. By utilizing a solar vapour generator, we effectively utilize the untapped infrared radiation to purify seawater/wastewater and generate water vapour as the feedstock for photocatalytic reactions, thereby maximizing the utilization of the complete solar spectrum. These hybrid systems demonstrated the capability to split seawater into H_2 and O_2.

Moreover, the hybrid systems exhibited the potential to produce CO by utilizing CO_2 and seawater as feedstocks under visible light. The integrated photocatalyst and solar vapor generation systems outperformed the photocatalytic systems in terms of H_2/CO production rates for seawater splitting and CO_2 reduction coupled with seawater oxidation. However, the observed production was not stoichiometric, indicating the presence of possible side reactions. Further investigations will be conducted to understand the underlying causes of this phenomenon and optimize the systems in future research.