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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

Photocatalysis provides a method to store solar energy as hydrogen through water splitting; however, its dependence on pure water limits its commercial viability. Increasingly, untreated water sources are being used to drive photocatalytic reactions. Yet, these systems often exhibit low performance and low long-term stability, raising questions about their practicality. An alternative approach involves using sunlight to generate water vapor from untreated water sources via solar vapor generators (SVGs). This water vapor can be used for subsequent water splitting reaction. Most photocatalytic water splitting systems can only utilize high-energy photons, leaving a significant portion of the solar spectrum unused. Therefore, integrating these two solar conversion technologies could realize the utilization of the entire solar spectrum.

To this end, we combined a photocatalytic device (PC) for producing hydrogen from water vapor with an SVG for clean water production, creating a single floating device (SVG-PC). This floating sheet uses the entire solar spectrum through the synergistic absorption of UV light by the PC top layer and visible–infrared light by the SVG, producing H_2 with a solar-to-hydrogen efficiency of $0.13 \pm 0.03\%$ using seawater as the feedstock. This integrated system remains stable in seawater and other aqueous waste streams by isolating the PC from contaminants in the liquid feedstock. This work introduces a new concept for off-grid energy production/storage and is a significant step towards solving energy and water supply challenges.