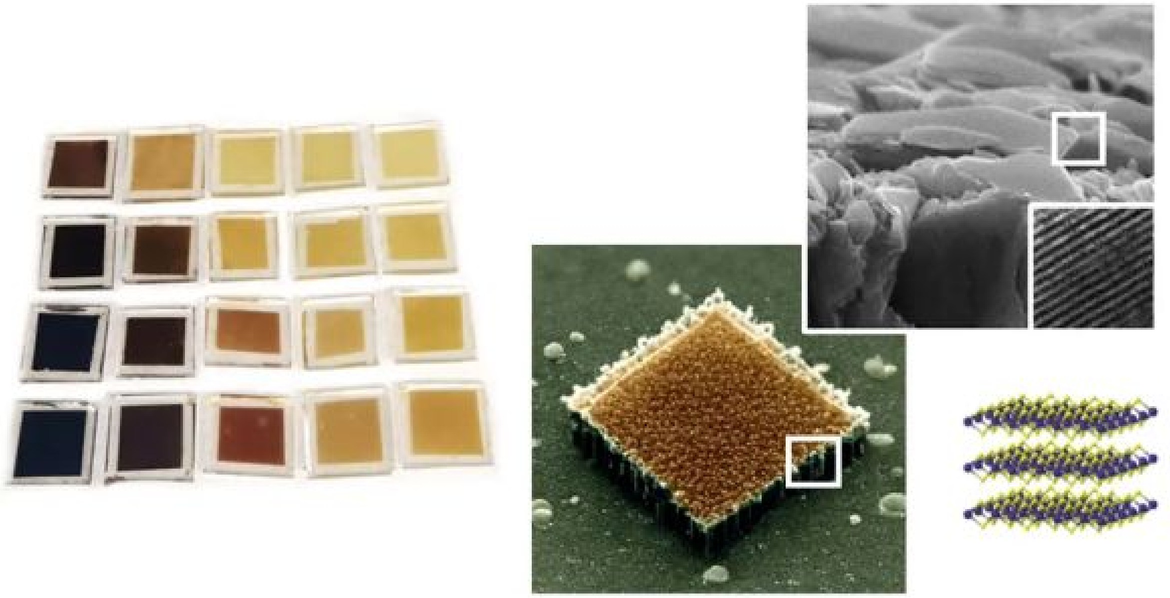

Photoanodes made from 2D tin sulfide nanosheets enhance the visible light absorption of photoelectrochemical devices

In a new study published in the International Journal of Hydrogen Energy, researchers demonstrate the potential of solution processed photoanodes made of 2D tin sulfide (SnS?) nanoshee s in photelectrochemical (PEC) Systems by showing its ability o absorb and convert visible light into chemical energy. The e results establish them as promising materials for enhancing P C applications, including solar fuels and hydrogen production.

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Photoelectrochemical (PEC) water splitting and CO2 reduction based on solar energy is a promising approach for the production of green hydrogen and the conversion of CO2 into renewable fuels or feedstock. However, the deployment of PEC systems is limited by the excessive band gaps of metal oxide photoanodes, which do not allow efficient visible light absorption. Mid and large band gap materials suitable for tandem applications remain difficult to find due to their cost, scarcity of abundant materials, or low efficiency.

Recently, 2D atomically thin transition metal chalcogenides (TMCs) such as WS2, WSe2, MoS2 , and MoSe2 have become the center of attention for their efficiency, tunability, and low cost, making them suitable for PEC applications as absorbers with shorter band gaps and also as catalysts for hydrogen and oxygen evolution reactions. Among these materials, tin sulfides (SnxSy) have attracted interest due to the abundance of tin and sulfur, their fabrication simplicity, semitransparency, and enhanced photocatalytic activity.

In this new study, ICFO researchers and SOREC2 team members, **Jordi Martorell** and **Carles Ros**, in collaboration with **Yudania Sanchez, Maxim Guc, Maykel Jimenez -Guerra** and **Alejandro Perez-Rodriguez** from Catalonia Institute for Energy Research (IREC); **Sara Marti-Sanchez and Jordi Arbiol** from Catalan Instiute of Nanoscience and Nanotechnology (ICN2); and **Shadai Lugo-Loredo** from Universidad Autonoma de Nuevo Leon (UANL), describe the fabrication and optimization of photoanodes made from 2D tin sulfide (SnS?) multilayer nanosheets using solution-processed techniques. Their work, recently published in the **International Journal of Hydrogen Energy**, reveals for the first time the visible light absorption and conversion capabilities of these 2D SnS?-based photoanodes.

The researchers fabricated the photoanodes using a two-step, solution-based process. At the nanoscale, samples fabricated with the highest annealing temperature (500 °C) exhibite
well-defined, multilayer, 2D hexagonal SnS? nanosheets exceeding 400 nm in width. Thi
phase also displayed the smallest electronically active bandgap, improving the material'
ability to convert visible light into electrical energy

The scientists further evaluated the photoelectrochemical capabilities of the fabricated SnS
layers, employed as photoanodes for the oxygen evolution reaction (OER) in
single-compartment water splitting cell. After optimizing post-treatment procedures, th
researchers obtained SnS? nanosheet samples that generated photovoltages exceeding 1.0
volts and photocurrents surpassing 1.6 mA/cm². Additionally, they measured the incide
t photon-to-current conversion efficiency (IPCE) of these enhanced SnS? samples. T
e researchers observed photon conversion by the SnS? nanosheets across the 500-900
m range (visible spectrum), with a maximum IPCE of 75% at 330 n
. i¿½The observed IPCE profile indicates that SnS? 2D nanosheet photoanodes fabri
ated using solution-processed means having a significant potential for enhancing absorptio
and conversion across the entire visible light spectrum, positioning them as promising mate
ials for efficient solar hydrogen productioni¿½, the authors
wrote. i¿½Our work contributes to a better understanding of transition metal sulfi
es as 2D photo-absorber materials in photoelectrochemical conditionsi¿½, said **Carles Ros**, co-author of the study.

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Original article

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