

From Photovoltaics to Solar Fuels: Cu(In,Ga)Se₂ Materials as Photoelectrodes for CO₂ Reduction

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Abstract:

Photoelectrochemical (PEC) CO₂ reduction offers a promising route to convert solar energy into chemical fuels while enabling carbon-neutral energy storage. Among photovoltaic absorbers, Cu(In,Ga)Se₂ (CIGS) stands out for its excellent light absorption, tunable band gap, efficient charge transport, and technological maturity, making it an attractive material for PEC applications. However, its implementation as a photocathode is limited by interfacial charge recombination, insufficient catalytic activity, and stability issues. This presentation examines the evolution from CIGS solar cells to CIGS-based photocathodes for CO₂ reduction, from bare semiconductors to hybrid architectures combining pn junctions, protective interlayers, and selective catalysts. The advantages, limitations, and future prospects of these approaches for solar fuel production will be discussed.

Keywords: Solar Fuels, CO₂ Reduction, Cu(In,Ga)Se₂ based photo-electrode, Hybrid photovoltaics-catalysis