Multifunctional photovoltaic window layers for CO_2 reduction

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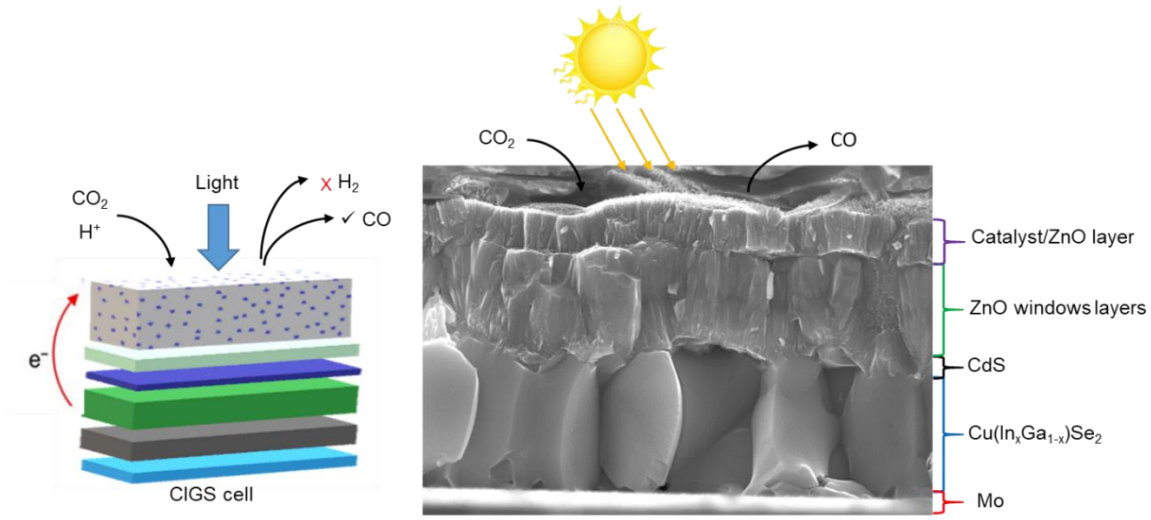
Summary: Photo-electrocatalytic (PEC) processes, which rely on solar light as energy source so as to drive highly selective chemical reactions, is a promising approach for CO_2 reduction (CO_2RR) and fuel production. However, for these systems the conversion efficiency is still low for industrial applications[2]. To achieve a high solar-to-fuel conversion efficiency, new strategies yielding high photocurrent along with sufficient photo-voltage should be developed. Recent advances in photovoltaic on the one hand and in molecular catalysis on the other hand open up new possibilities for improving photo-conversion of CO_2. We have developed transparent and conductive nanostructured layers integrating a molecular catalyst, which can be simultaneously used as a window and a protective layer for solar cells, creating a complete photo-electrode for solar to fuel conversion. More specifically, hybrids ZnO/catalyst layers were prepared by a simple one step electrochemical deposition on ZnO:Al window layers of Cu(In,Ga)Se_2 based solar cells (CIGS). Combination of hybrid ZnO with a very low concentration of encapsulated molecular catalyst inside the oxide layer can lead to a high catalytic response for the CO_2 reduction. The modified CIGS cells show conversion of CO_2 to CO with 98% Faradaic efficiency and 95% CO selectivity at high current densities (up to several ca. mA cm^{-2}). These results will be discussed.



1. Spurgeon, J. M.; Kumar, B. *Energy Environ. Sci.* **2018**, *11* (6), 1536–1551.
2. Luo, W. et al. *Applied Catalysis B: Environmental* **2020**, *273*.
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