CIGS photocathode functionalized with a molecular cobalt catalyst for selective carbon dioxide reduction in water

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Solar-driven conversion of CO_2 into CO is a key transformation for artificial photosynthesis. A photocathode based on p-type Cu(In,Ga)Se_2 (CIGS) semi-conductor and cobalt quaterpyridine (Co-qPy) molecular catalyst has been developed, in 2 configurations. First, an external CIGS photovoltaic cell (ZnO:Al/ZnO/CdS/CIGS/Mo material) was associated with the **Co-qPyH|m-TiO_2** electrode (**Fig. 1 a**). Upon illumination and polarization of the cathode to a weakly negative potential (-0.03 V vs. RHE, pH 7.2), a large average current density of 1.78 mA cm^{-2} was obtained for 7 hours, corresponding to CO_2 catalytic reduction to CO with a selectivity of 82%. In a second approach, a fully integrated photoelectrochemical cell (PEC) was set upon depositing flat TiO_2 layer directly on top of the ZnO:Al /ZnO/CdS/CIGS/Mo stack and further functionalizing it with Co-qPyH (**Fig. 1 b**). During the long-term photo-electrocatalysis experiment carried out at a bias potential of -0.06 V vs. RHE, an average current density of 0.8 mA cm^{-2} was recorded (several hours). Selectivity of 97% for CO was obtained. Notably, this work led to the first PEC device demonstrating photoelectrocatalytic activity in pure aqueous medium with 97% of selectivity for the CO_2 reduction to CO. It opens new perspectives for better performing photocathode PECs for CO_2 reduction. [1]

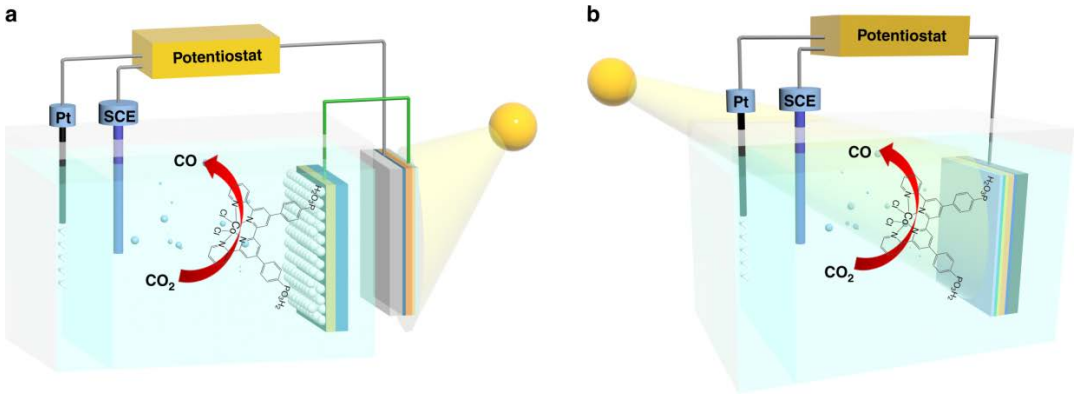

Figure 1 Photo-assisted cell systems. PV–EC system (a) and PEC system (b).

Reference

[1] P. B. Pati, E. Boutin, R. Wang, S. Diring, S. Jobic, N. Barreau, F. Odobel, M. Robert, Nat. Commun. 2020, 11:3499.