Selective carbon dioxide reduction from the combination of CIGSe thin films and molecular cobalt catalyst: issues and tricks to achieve efficient and long term operating photocathodes.

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Artificial photosynthesis is a vibrant field of research aiming at converting abundant, low energy molecules such as water, nitrogen or carbon dioxide into fuels or useful chemicals by means of solar energy input. Photo-electrochemical reduction of carbon dioxide is an appealing strategy, aiming at reducing the greenhouse gas into valuable products such as carbon monoxide at low or without bias voltage. Yet, in such configuration, there is no catalytic system able to produce carbon monoxide selectively in aqueous media with high activity, and using earth-abundant molecular catalyst. Upon associating a Ga-rich Cu(In,Ga)Se_2 thin film with cobalt quaterpyridine complex, for the first time we successfully fabricated a photocathode complying with the aforementioned requirements. Pure carbon dioxide dissolved in aqueous solution (pH 6.8) is converted to carbon monoxide under visible light illumination with partial current density above 3 mA/cm² and 97% selectivity, showing good stability over time.
The present contribution aims at showing the motivation for employing versatile CIGS technology, and presenting materials and stack optimizations to achieve efficienct and long term operating photocathodes.

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