Photoelectrochemical ammonia production using copper oxide photocathodes

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Photoelectrochemical Nitrogen(N2) reduction (PENRR) is an attractive pathway to convert ammonia (NH3), which is not only an essential commodity but also a sustainable carbon-free fuel, under ambient temperature and pressure using water as a hydrogen source. By utilizing incident solar energy, PENRR can significantly reduce energy input required for NH3 production. In this study, the activity of PENRR was investigated using copper oxide (Cu_2O and CuO) photocathodes. Under the simulated solar illumination, the Cu_2O and CuO photocathodes produced NH_3 with a Faradic efficiency (FE) of 20 % and 17% at 0.6 V and 0.4 V vs. RHE, respectively. The set potentials are significantly more positive than the thermodynamic reduction potential of N_2 ($N_2(g) + 8H^+ + 6e^- \rightleftharpoons 2NH_4^+(aq)$, $E^0 = 0.275$ V vs. SHE). The results of PENRR demonstrate how the photovoltage gain by the Cu_2O and CuO photocathodes can reduce the energy input required for NH3 production. In this talk, we will present interesting and informative research progresses using copper oxides for PENRR utilizing solar energy.