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Nanowire arrays for selective and durable CO_2 reduction

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The rapid changes in the global climate during the last century have been extensively ascribed to anthropogenic CO_2 emissions caused by the combustion of fossil fuels. Efforts are then required to decrease the consumption of fossil fuels and to develop methods to produce renewable carbon- based fuels. One promising approach is artificial photosynthesis, a process in which solar energy is used to drive the reduction of CO_2 to fuels or valuable chemicals. A pressing need exists to develop an efficient, robust, selective and earth-abundant catalyst for the CO_2 reduction reaction (CO_2RR), which can be used directly as a cathode in a photovoltaic-electrolyzer system or coated on an efficient light absorbing photocathode material in a photoelectrochemical (PEC) cell. Copper (Cu) is a non-toxic and earth-abundant catalyst for the CO_2RR, and there are facile and scalable methods to make its nanostructures, etc. and as such it is arguably the best-studied catalyst for the CO_2 reduction. However, its reported performance (considering selectivity, durability, and efficiency) so far is too low for practical applications. Herein, we present our efforts to nanoengineer efficient CO_2RR catalysts. Among them, I will highlight our production of $Cu(OH)_2$ nanowire arrays, synthesized by a facile and scalable solution growth method, for selective and durable CO_2 reduction. The $Cu(OH)_2$ nanowire array shows selective CO_2 reduction to C_2-C_3 products, with a faradaic efficiency of ~40% for C_2^+ products. The catalysts exhibit durable CO_2 reaction of over 24 hours with a minimal change in faradaic efficiency of each gas/liquid product and total faradaic efficiency.

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