Natural Leaf Inspired Z-scheme Photocatalytic CO_2 Reduction by 3-Dimensional $BiVO_4$/Carbon-coated Cu_2O Nanowire Arrays under Visible Light

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Most promising and attractive CO_2 conversion photocatalysts developed thus far suffer from quite low CO_2 photoconversion efficiency due to serious bottlenecks. In this study, we present Z-scheme photocatalyst for carbon dioxide reduction by 3-dimensional $BiVO_4$/carbon coated Cu_2O nanowire array which is inspired from natural leaf. 3-D structure enhanced surface area and mass transport and charge transport. High redox potential with significantly decreased electron-hole recombination can be obtained by Z-schematic electron flow between $BiVO_4$ and Cu_2O and mediation by ultrathin carbon layer. Also, protecting effect of carbon layer and Z-scheme charge flow induced outstanding photostability of Cu2O that is retention of 98% activity after 20hours reaction. We achieved ~3μmol/g/h CO formation rate in visible light irradiation that is 9.4 and 4.7times higher than those of Cu_2O mesh and Cu_2O nanowire arrays, respectively. We present characterization with various analysis method and prove Z-scheme charge flow mechanism by using coumarin as a probe molecule.