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Nano-Lattice Engineering of Cu-Oxides via Flame Spray Pyrolysis: Challenges for Promoting Artificial Photosynthesis Performance

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Extended Abstract

The “Artificial Photosynthesis” approach aims to exploit photocatalytic technology, i.e. that is the use of solar photons to produce hydrogen (H_2) and -ideally- couple it to CO_2 reduction towards carbon-based fuels. Economically and environmentally, this is a sustainable, circular economy approach since CO_2 reduction can result in useful products such as formic acid (HCOOH), formaldehyde (HCHO), methanol (CH_3OH), methane (CH_4). Cu-oxide nanophases [CuO, Cu_2O, Cu^0] constitute highly potent nanoplatforms for the development of efficient Artificial Photosynthesis catalysts. Herein we have developed a novel Flame Spray Pyrolysis (FSP) technology[1,2] for industrial-scale synthesis of anoxic (Cu_2O, Cu^0) nanophases heterojunctioned with oxic CuO nanophase in one-step. The mechanisms of Photocatalytic H_2 production form H_2O and selective CO_2 reduction to HCOOH are discussed for mixed-phase [$Cu_2O/Cu^0/CuO$] nanojunctions [3,4]. Control of oxygen-stoichiometry in the FSP-process was screened in the range of φ=0.5 to 1.5 as a key-parameter to control the [$Cu_2O/Cu^0/CuO$] nanojunctions. We show that enhanced CO_2-reduction >2000umoles/gr/h can be achieved by proper [$Cu_2O/Cu^0/CuO$] phase composition, not pure phases. This phenomenon is discussed in the context of electron-hole life time control and photocorrosion control [5].

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