

Photoelectrochemical reduction of carbon dioxide to methanol on *p*-type CuFe_2O_4 under visible light irradiation

Kaykobad MdRezaul Karim^a; Huei RueyOng^{ab}; HamidahAbdullah^a; AbuYousuf^c; Chin KuiCheng^a; Md MaksudurRahman Khan^{ad}

^aFaculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

^bFaculty of Engineering and Technology, DRB-HICOM University of Automotive Malaysia, 26607 Pekan, Pahang, Malaysia

^cDepartment of Chemical Engineering and Polymer Science, Shahjalal University of Science and Technology, Sylhet 3114, Bangladesh

^dCentre of Excellence for Advanced Research in Fluid Flow (CARIFF), Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

ABSTRACT

Artificial photosynthesis has the potential to produce solar fuels from CO_2 and H_2O using an efficient photocatalyst. Semiconductor with low band gap and high stability is always the right candidate to be used as photocatalyst. Photocatalytic (PC) reduction of CO_2 suffers from slow reaction kinetics and poor yield of product. Photocatalytic reaction in assistance with judicious bias potential is a solution to increase the catalytic activity and reduce the electron/hole (e^-/h^+) recombination rate. In the present work, a *p*-type CuFe_2O_4 was synthesized and used for photoelectrochemical (PEC) CO_2 reduction. The catalyst was characterized by UV-visible spectroscopy (UV-vis), Mott-Schottky (MS), chronoamperometry, X-Ray powder diffraction (XRD), X-Ray photoelectron spectroscopy (XPS) and transmission electron microscopy (TEM). Methanol was found as only product in liquid phase produced by photoelectrochemical reduction of CO_2 at a bias potential of -0.5 V (vs NHE) under light irradiation (at 470 nm). The quantum efficiency and incident photon to current efficiency (IPCE) were found as 14.4% and 5.1% respectively revealed that, CuFe_2O_4 is a potential photocathode for PEC of CO_2 reduction.

KEYWORDS:

CuFe_2O_4 ; CO_2 reduction; Photoelectrochemical reduction; IPCE; Quantum efficiency