Electrospun hematite nanowires for photoelectrochemical cell

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Abstract

Solar energy is an efficient source that provides enough power for all global energy demands if it can efficiently harvested. The more elegant, practical and potentially more efficient way to store this huge energy is fix this electromagnetic energy to molecular bonds in the form of chemical energy as analogous to photosynthesis process exploit by nature[Allen J bard, 1995]. In the view of simplicity and ecology, Photoelectrolysis is very promising technique for photoelectrochemical conversion of solar energy. Hematite (α-Fe_2O_3), a binary metal oxide material, is n type in its pure form crystallizes in corundum structure. Due to its significant light absorption, abundance, chemical stability in an aqueous environment and low cost, it emerged as a model material for water splitting electrode and received considerable attention during last few years. Unfortunately this material produces low photocurrent due to its short exciton life time (~10ps), poor charge carrier mobility and slow water oxidation kinetics [Osterloh, 2013]. To overcome these limitations and improves solar conversion efficiency intense effort has been done as development of such nanostructure that facilitate electron transport and reduce charge recombination[Kay *et al*., 2006][Ling *et al*., 2011], modification of electronic structure by elemental doping [Liao *et al.*, 2011] and use of oxygen evolution catalyst [Krengvirat *et al.*, 2012]. One dimensional nanostructure typically nanowires are promising as this morphology reduces charge transport resistance and has high surface area. Electrospinning is one of the bottom up approach which is simple, cost effective and can be scale up this technique works on the principle of liquid injection and jet formation that travels through an electric field and formation of Nanofibers on a substrate.[Bhardwaj *et al.*,2010] The diameter of nanofibers can be tuned by liquid injection rate, distance form collector and Variation of potential difference.[Archana *et al.*, 2009].

In the present study pure hematite nanofibers were prepared by Electrospinning. The crystal structure of fibers was studied by X-ray diffraction technique, physical morphology by FESEM and particulate properties by BET surface area measurements. The fibers were pure hematite with hexagonal structure having diameter ranging from 50 nm to 100nm and had a specific surface area of $14m^2$/gm. Photoelectrochemical cells were prepared using these hematite nanowires showing photocurrent density of $0.24mA/cm^2$.

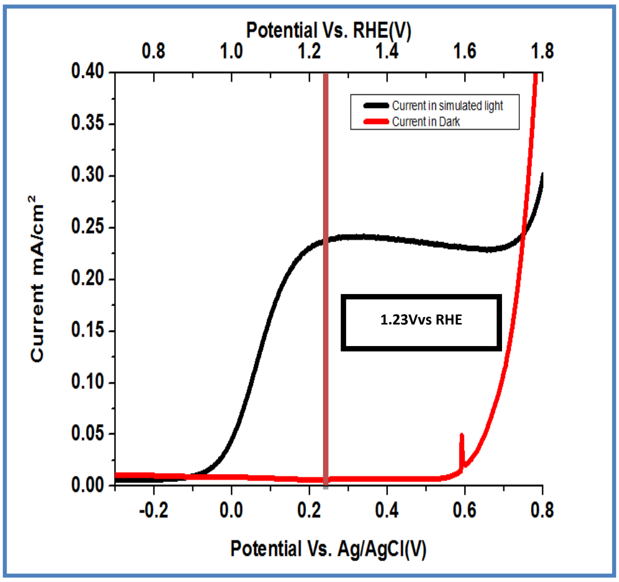

Fig 1: Photocurrent density verses applied potential under simulated light and dark.

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