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CATHODIC ELECTRODEPOSITION OF ZnO THIN FILMS

FOR SOLAR ENERGY CONVERSION

A PROJECT REPORT PRESENTED BY

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Zinc oxide (ZnO) thin films on fluorine doped conducting glass substrates (FTO) have been obtained from a solution containing 0.01 mol dm^{-3} $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, 0.1 mol dm^{-3} KNO_3 and 0.1 mol dm^{-3} ZnCl_2 in propylene carbonate, by galvanostatic electrodeposition under various conditions. The most uniform and smooth films were obtained by passing 2.0 mA cm^{-2} for 75 minutes at a bath temperature of 28°C .

These films were characterized by electrochemical techniques, X-ray diffraction, optical methods and scanning electron microscopy (SEM). The optical transmittance at 800 nm is around 90 % or higher for most of the films and the optical band gap of the samples annealed at 550°C was around 3.2 eV . It has been observed by the SEM that the annealed ZnO films show less porosity between the grains than the as prepared films. The surface conductivity measurements of these films indicate an approximate value of $25.6 \text{ M}\Omega$ per square centimetre.

Dye sensitized solar devices were fabricated using these electrodeposited ZnO films with ruthenium (N3) dye [*cis*-di(thiocyanato)-N,N'-bis(2,2'-bipyridyl-4,4'-dicarboxylic acid)ruthenium(II) complex] and an electrolyte consisting of redox I₃⁻/I⁻ couple and their photo responses were observed. The cells delivered a respectable output with an open circuit voltage of 607 mV and a photocurrent density of 2.13 mA cm⁻² at an efficiency of 0.51%.

Apart from that polycrystalline *n*-ZnO/ *p*-Cu₂O heterojunctions were grown for the first time by electrodepositing Cu₂O thin films on ZnO films and significant photo responses were observed.