ABSTRACT

This study was undertaken to identify a more convenient prototype dye, compared to the earlier reported cyanidin, for the fabrication of the dye-sensitized nano-porous solid-state photovoltaic device and to further investigate the performance of the device.

It was found that copper chlorophyllin can be successfully employed for the fabrication of the n-TiO_2/copper chlorophyllin/p-CuI cell. The photo-excited pigment is found to inject electrons into n-TiO_2 and holes into p-CuI generating photocurrent and photovoltage that are significant for a solid-state dye-sensitized cell. However, in the presence of oxygen, moisture and UV light the cell exhibits a rapid decay in photocurrent and photovoltage. It was found that the decay of the photocurrent and photovoltage in n-TiO_2/copper chlorophyllin/p-CuI cell is almost completely suppressed, provided oxygen, moisture and UV-light ($\lambda \leq 348$ nm) are excluded.

It was also observed that the peak at 360 nm originating from bandgap excitation of TiO_2 in the photocurrent action spectrum of the n-TiO_2/cyanidin/p-CuI of n-type semiconductor/dye/p-type semiconductor (NDP) cell, attains a maximum for a certain critical surface concentration of cyanidin.

Inorganic heavy metal ions form complex anions with sacrificial oxidizing agents such as citrate ions and tartarate ions. In the oxidative photodegradation of these complexes with TiO_2, metals are found to become deposited on TiO_2. The reactions are sufficiently sensitive to sunlight and, for practical application, TiO_2 can be confined in a transparent dialysis bag to facilitate the disposal of extracted metals. Photocatalytic removal of Cu^{2+} from aqueous media in the presence of tartarate ions was carried out as a model system by this method.

As an alternative method, It was found that TiO_2 particles affixed to the surface of polypropylene films can be conveniently utilized to extract metals such as Cd, Pb, Hg, Ag, Bi and Cu in the presence of citric acid which acts as a sacrificial and complexing agent. As an example, photoextraction of lead from aqueous solution is described.