Experimental and CCD Optimization studies for Photoelectrochemical degradation of Organic dyes using Catalyst of $Co_xFe_{3-x}O_4$ thin films.

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Cobalt ferrite thin films have been prepared by depositing $Co_xFe_{3-x}O_4$ powders on indium tin oxide (ITO) substrates by the drop casting method. The crystallographic structure of thin films is the same as the powder, and the chemical composition was checked by energy dispersive spectroscopy (EDS). Mott-Schottky analysis was used also to determine the flat band potential. The study also included photocurrent measurements to assess the carrier density. The photoelectrocatalytic performance of the prepared $Co_xFe_{3-x}O_4$ thin films was evaluated for the removal of Rhodamine B from water under irradiation with a 390 nm light source using a photoreactor with three electrodes immersed in an electrolyte. Response surface methodology (RSM) was used to evaluate the effect of electrolyte concentration (Na_2SO_4), current density, dye concentration (RhB) and irradiation time, and to optimize the catalytic process. The band gap values of the samples estimated to be, approximately 2.32, 2.01eV corresponding to $CoFe_2O_4$ and $Co_{1,5}Fe_{1,5}O_4$ respectively. Grain size distribution was broad, with a value between 6 and 12 nm. In addition, the flat band potential (V_{FB}) for the $CoFe_2O_4$ nanoparticles was obtained from the Mott-Schottky plots measured at 1000Hz. The positive slope of the plot indicates that the $CoFe_2O_4$ material is a n-type semiconductor, which agrees with the results of the literature. The estimated V_{FB} value of the $CoFe_2O_4$ nanoparticles was 0.28V vs. Ag/AgCl (Reference electrode). The $Co_xFe_{3-x}O_4$ thin films showed remarkable efficiency in the photoelectrocatalytic test and the CCD model based on RSM methodology established the most important parameters that affect the PEC activity and the optimum conditions to achieve the 100% RhB degradation.