

SUMMARY

The textile industry uses a relatively large amount of dyes to carry out the production process, one of these dyes is congo red. However, excessive use can harm the environment and human health. In the structure of congo red there is an azo group which is carcinogenic and difficult to decompose in the environment. Further handling needs to be done to prevent the adverse effects of congo red dyes. Photoelectrocatalysis is a method that has great potential to decolorize congo red solutions by utilizing photon energy using electric current. This research aims to synthesize Fe-doped ZnO semiconductor material to be applied as a thin layer anode in decolorizing congo red solution. The synthesis of ZnO and ZnO-Fe was carried out using sol-gel method which was attached to ITO glass substrate by dip coating technique. The thin layer anodes were then characterized using XRD, SEM-EDX, and UV-DRS instruments. The effectiveness of congo red solution decolorization by photoelectrocatalysis of each anode was measured using UV-Vis spectrophotometry.

Fe-doped ZnO was synthesized using 3% and 5% Fe concentration variations. Thin layer anodes of ZnO/ITO and ZnO-Fe/ITO were characterized using XRD to determine the crystal structure, SEM-EDX to identify the anode surface morphology and constituent elements, and UV-DRS to measure the band gap energy value. Thin layer electrodes were used to decolorize 20 mg/L congo red solution with variations in photoelectrocatalysis application time of 0, 20, 40, 60, 80, and 100 minutes. The potential used on the ZnO/ITO and ZnO-Fe3%/ITO anodes is 1 V and ZnO-Fe5%/ITO is 2 V. After application, the congo red solution was measured by UV-Vis spectrophotometry to determine the decrease in absorbance and concentration of the solution.

The results showed that ZnO and ZnO-Fe thin layer anodes were successfully synthesized and deposited on ITO glass substrates. XRD characterization analysis shows that the thin layer electrode has a hexagonal wurtzite structure and Fe dopant does not change the structure formed. SEM-EDX characterization shows the formation of material such as sheets (flakes) on the anode and Fe is confirmed to be on the ZnO site. While UV-DRS characterization shows a decrease in band gap energy in ZnO/ITO, ZnO-Fe3%/ITO, ZnO-Fe5%/ITO respectively by 3.04 eV, 3.00 eV, and 2.88 eV. The photoelectrocatalysis process has increased the effectiveness of decolorization using ZnO-Fe/ITO anode. The percentage of congo red solution decolorization on ZnO/ITO, ZnO-Fe3%/ITO, and ZnO-Fe5%/ITO anodes were 65.56%, 84.27%, and 93.97%, respectively.