

## ABSTRAK

*Counter electrode* (CE) merupakan komponen penting pada DSSC yang memiliki pengaruh signifikan pada kinerja fotovoltaiik. Bahan yang sering digunakan sebagai *counter electrode* DSSC adalah platina (Pt). Akan tetapi, platina memiliki beberapa kelemahan diantaranya sebagai logam mulia, bahan ini keberadaannya di alam tidak melimpah sehingga sulit digunakan untuk komersial serta dapat terkorosi oleh reaksi redoks  $I/I_3^-$ . Pada penelitian ini *counter electrode* dibuat dari nanokomposit MWCNT-Fe<sub>2</sub>O<sub>3</sub> dengan variasi massa MWCNT (25 mg, 50 mg, dan 75 mg). Karakterisasi dilakukan menggunakan XRD, SEM, CV, dan EIS. Hasil XRD menunjukkan fase dominan hematit ( $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>) tanpa deteksi puncak MWCNT, hal ini diakibatkan rasio massa yang rendah dan kurangnya homogenitas. Analisis SEM mengungkapkan aglomerasi pada semua variasi, dengan struktur tidak merata akibat interaksi kurang optimal antara Fe<sub>2</sub>O<sub>3</sub> dan MWCNT. Uji CV menghasilkan *peak-to-peak separation* ( $\Delta E_p$ ) seragam sebesar 0,799613 V. Nilai kerapatan arus puncak reduksi ( $j_{pc}$ ) tertinggi dicapai pada variasi 50 mg MWCNT (0,0127 mA/cm<sup>2</sup>). Hasil EIS menunjukkan variasi MWCNT mempengaruhi nilai resistansi transfer muatan ( $R_{ct}$ ). Semakin banyak massa MWCNT semakin rendah nilai  $R_{ct}$ .

**Kata Kunci:** DSSC, *Counter Electrode*, Nanokomposit, MWCNT-Fe<sub>2</sub>O<sub>3</sub>.

## ABSTRACT

*The counter electrode (CE) plays a vital role in dye-sensitized solar cells (DSSCs), significantly affecting their photovoltaic performance. Platinum (Pt) is widely employed as a CE material due to its excellent catalytic activity. However, the high cost, limited natural abundance, and susceptibility to corrosion in the  $I^-/I_3^-$  redox electrolyte limit its potential for large-scale commercialization. In this study, MWCNT- $Fe_2O_3$  nanocomposites were utilized as alternative CE materials, with varying MWCNT masses (25 mg, 50 mg, and 75 mg). The nanocomposites were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS). XRD analysis confirmed the dominant presence of hematite ( $\alpha$ - $Fe_2O_3$ ), with no observable MWCNT peaks, which may be attributed to the low mass ratio of MWCNTs and insufficient dispersion within the matrix. SEM images revealed significant agglomeration and non-uniform morphology in all samples, likely due to weak interfacial interactions between  $Fe_2O_3$  and MWCNTs. Electrochemical characterization by CV exhibited a consistent peak-to-peak separation ( $\Delta E_p$ ) of 0.799613 V across all compositions, while the highest cathodic peak current density ( $j_{pc}$ ) of  $0.0127 \text{ mA}\cdot\text{cm}^{-2}$  was observed in the sample containing 50 mg of MWCNTs. EIS analysis indicated a decreasing trend in charge transfer resistance ( $R_{ct}$ ) with increasing MWCNT content, suggesting enhanced electrical conductivity and catalytic activity of the nanocomposite CEs.*

**Keyword:** DSSC, Counter Electrode, Nanocomposite, MWCNT- $Fe_2O_3$ .