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Abstract

This study evaluated the reduction of CO_2 to methanol in the presence of effective and stable MWCNTs impregnated with Cu_2O. A preliminary DFT study shows that the incorporation of Cu_2O in MWCNTs improves the electronic properties of the electrocatalyst. The surface morphology and structural interaction between Cu_2O and MWCNTs at different Cu_2O loadings (10-50 wt %) were characterized by SEM, TEM, EDX, XRD, BET, TGA, and Raman spectroscopy. Characterization results show that the Cu_2O particles are incorporated at defect sites in the MWCNT matrix. However, higher lodgings (40 and 50 wt %) result in the agglomeration of Cu_2O particles and crystallite size growth. Electrochemical evaluation of the catalyst for CO_2 reduction was conducted in a two-component polycarbonate electrochemical cell. Linear sweep voltammetry results show that the 30% Cu_2O-MWCNTs catalyst gives the highest current density in the entire potential range, and a faradaic efficiency of 38% was achieved at -0.8 V for the reduction of CO_2 to methanol. The study shows that the impregnation of Cu_2O on MWCNTs affects the structural and electronic properties of the electrode, which in turn improves both the activity and stability of the catalyst as confirmed by chronoamperometry.

Keywords: Multi wall carbon nanotubes, CO_2 reduction, Cu_2O electrocatalyst, Methanol, Faradaic efficiency