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ELECTROCATALYTIC REDUCTION OF CO_2 USING N,N′-BIS(SALICYLALDEHYDE)ETHYLENEDIAMINE COPPER(II) COMPLEX

R.W.P.K.J.M.L.I.K. Thalgahagoda[1] and M.Y.U. Ganehenege[2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*myug@sci.pdn.ac.lk

Environmental pollution caused by emission of CO_2 is regarded as one of the biggest global issues in the 21st century. Electrochemical reduction of CO_2 using metal Schiff base complexes as catalysts to obtain required chemicals, such as oxalic and formic acids, has garnered attention among other methods. In this regard, the research presented here mainly focuses on the synthesis of efficient electrocatalysts to bind and reduce CO_2 into valuable products. This research details the electrocatalytic reduction of CO_2 using N,N′–bis(salicylaldehyde)ethylenediamine copper(II) complex [Cu^{2+}(Salen)] as the electrocatalyst. It exhibited a higher catalytic efficiency than the starting Cu(II) salt [$Cu(CH_3COO)_2.H_2O$], demonstrating the critical role of the ligand environment in tuning the catalytic activity. Cyclic voltammetric studies, carried out in DMSO using tetraethylammonium hexafluorophosphate as the electrolyte and the three electrode system comprising a glassy carbon working electrode, Ag/AgCl reference electrode and Pt wire auxiliary electrode, revealed that [(Cu^{2+}(Salen)]/[(Cu^{+}(Salen)] reduction takes place at –1.2 V and the reduced form of the [Cu(Salen)] complex is capable of catalysing CO_2 reduction around –0.9 V that is significantly lower than the potential required to reduce CO_2 in the absence of a catalyst. The efficiency of reduction in terms of $i(CO_2)/i(N_2)$ ratio is 1.63. The large difference in the reduction and oxidation peak potentials of the quasi-reversible cyclic voltammetric wave may be due to the overlapping multi-electron processes.

Keywords: Catalytic reduction, CO_2 reduction, Copper-Schiff base complexes, Cyclic voltammetry, Electrocatalyst