**Abstract**

In this thesis, three mononuclear Ru(III) complexes, [Ru(dmb)(CH3CN)Cl3], [Ru(dmb)(CH3CN)3Cl](PF6)2 and [Ru(dmb)(tptz)Cl](PF6)2 where dmb is 4,4*'*-dimethyl-2,2*'*-bipyridine and tptz is 2,4,6-tris(2-pyridyl)-1,3,5-triazine, were synthesized and characterized by elemental analysis, FT-IR, UV-Vis and fluorescence spectroscopy. The electrocatalytic reduction of CO2 to CO by these complexes has investigated by cyclic voltammetry technique. The voltammograms showed that the multi-electron reduction of CO2 was catalyzed by the metal complexes and a proper mechanism was proposed for these reduction reactions. Gd2O3 nanoparticles were also synthesized through calcination of [Gd(MEO)3(DMF)3(H2O)2] at 600°C for 2 hours. The Gd(III) complex showed several intense emission bands at UV and Vis regions. XRD study of nano oxide Gd2O3 indicated a cubic crystal system. The nano particles are pure and have a particle size about 10-30 nm.

Key words

Ruthenium, 4,4*'*-Dimethyl-2,2*'*-bipyridine, 2,4,6-Tris(2-pyridyl)-1,3,5-triazine, Polypyridyl complexes, SEM, Calcination, Electrocatalytic reduction