# Synthesis and characterization of bimetallic complexes of $[Dy(en)_3(OH_2)][Fe(ox)_3]\cdot 2H_2O$, $[Dy(en)_3(OH_2)]_4[Co(ox)_3]_3\cdot H_2O$ and $[Dy(en)_3(OH_2)]_4[Ni(ox)_3]_3\cdot 5H_2O$, study of their electrocatalytic effect for reduction of $H^+$ to $H_2$ and synthesis and characterization of $Fe_2O_3\cdot Dy_2O_3$, $Co_3O_4\cdot Dy_2O_3$ and $NiO\cdot Dy_2O_3$, study of their catalyst effect for reduction of $CO_2$ to CO and magnetic properties

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## Abstract

In this thesis, three bimetallic complexes of Dy(III) with Co(II), Fe(III) or Ni(II), $[Dy(en)_3(OH_2)][Fe(ox)_3]\cdot 2H_2O$, $[Dy(en)_3(OH_2)]_4[Co(ox)_3]_3\cdot H_2O$ and $[Dy(en)_3(OH_2)]_4[Ni(ox)_3]_3\cdot 5H_2O$ (where en= ethylenediamine and ox=oxalate), were synthesized and characterized by elemental analysis, FT-IR, UV-vis and TGA/DTA techniques. The electrocatalytic activity of the bimetallic complexes for reduction of $H^+$ was investigated by cyclic voltammetry in sulfuric acid solution. The bimetallic complexes were used for preparation of three mixed metal oxides nanoparticles, $Fe_2O_3\cdot Dy_2O_3$, $Co_3O_4\cdot Dy_2O_3$ and $NiO\cdot Dy_2O_3$, using calcination method at three different temperatures (500, 600 and 800˚C)The nanoparticles were characterized by FT-IR, UV-vis, FE-SEM and XRD. Their particle size is in the range of 10-40 nm. The electrocatalytic activity of the nanoparticles for electro reduction of $CO_2$ to CO was also studied by cyclic voltammetry in $CH_3CN$. In addition, the magnetic property of the nanoparticles was investigated by super conductive quantum interface devise (SQUID).The result show a paramagnetic behaviour for three nanoparticles.

Keywords:
Electrocatalytic, Mixed metal oxides nanoparticles,Calcination, $CO_2$ Reduction, Cyclic voltammetry, Magnetic behaviour