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Synthesis and Characterization of Nanoparticles from the System $Ce_{1-x}O_2$-M_xO (M = Cu, Co)

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Abstract – The synthesis of nanoparticles from the system $Ce_{1-x}O_2$-M_xO (M = Cu, Co) was achieved via a polymeric precursors method, Pechini method. The samples were characterized by X-Ray diffraction, BET specific surface area, diffuse reflectance spectra and colorimetric coordinates L*, a*, b* using the CIE-L*a*b* method. X-Ray diffraction patterns show the presence of pure cubic CeO_2 phase for all the samples. The $Ce_{0.9}O_2$-$Co_{0.1}O$ sample presented the highest specific surface area. The powders presented a variety of colors from yellow to brown and gray.

In recent years, mixed oxides catalysts, based on ceria (MO-CeO_2, M = Cu, Co) have attracted much attention. The catalytic activity of oxides is linked to their capability of providing adsorbent oxygen species at their surfaces and to an easy extraction of their lattice oxygen to form oxygen vacancies [1]. CeO_2 is a chemically stable oxide, with an outstanding capacity to store or release oxygen. This property is linked to the variation of the oxidation state of cerium between +3 and +4, under various reductive or oxidizing conditions. In this work, nanoparticles from the system $Ce_{1-x}O_2$-M_xO (M = Cu, Co) with x = 0.03, 0.05 and 0.1, were synthesized via the polymeric precursors method, Pechini method.

Polymeric precursor method is based on the polymerization of metallic citrate using ethylene glycol. A hydrocarboxylic acid such as citric acid is normally used to chelate cations in an aqueous solution. The addition of a polyalcohol such as ethylene glycol leads to the formation of an organic ester. Polymerization promoted by heating to around 100℃ results a homog enous resin in which the metal ions are distributed uniformly throughout the organic matrix. The resin is then calcined to produce the desired oxide.

The samples were characterized by X-Ray diffraction, BET specific surface area, diffuse reflectance spectra and colorimetric coordinates L*, a*, b*. X-Ray diffraction measurements detected the presence of cubic CeO_2 for all synthesized samples. Secondary phases were not observed for the powders. The samples presented a reduction in specific surface area with increasing CuO content and an increase in specific surface area with increasing CoO content. The CeO_2 sample has a yellow color, $Ce_{1-x}O_2$-Cu_xO samples presented a gray color and the $Ce_{1-x}O_2$-Co_xO samples presented a brown color. The Pechini method revealed efficient for the synthesis of $Ce_{1-x}O_2$-M_xO (M = Cu, Co) catalysts with pure CeO_2 phase.

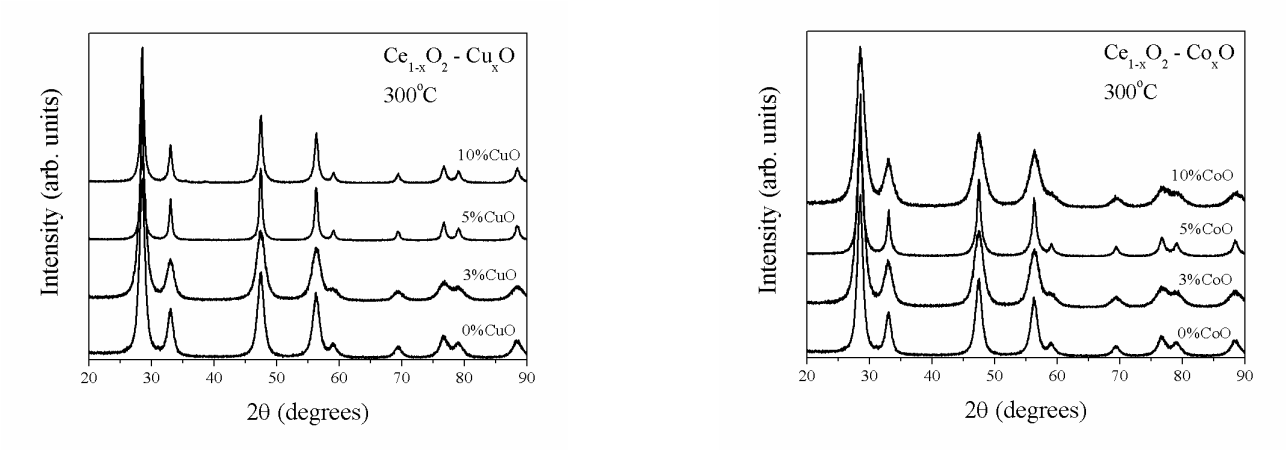

Figure 1: X-Ray diffraction patterns of $Ce_{1-x}O$-M_xO (M = Cu, Co) samples calcined at 300 ºC for 2h.

References

[1] A. Kopia, K. Kowalski, M. Chmielowska and Ch. Leroux. Surface Science 602, 7 (2008) 1313–1321.