Synthesis by Hydrogen Reduction and Characterization of CuNiCo with Nanoparticles

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Abstract

Metals alloys are of great technological interest which may even increase if they are nanostructured. Also, it can be found in the literature same proposed chemical synthesis methodologies in order obtain different kind of materials with nanocrystals particles. Then, the main objective of this work was to obtain a CuNiCo alloy, by an alternative procedure capable of generating nanostructured grains, followed by its preliminary characterization. It has been done by dividing the process into two steps: the first one is the thermal decomposition of a nitrate solution [$Cu(NO_3)_2$, $Ni(NO_3)_2$ and $Co(NO_3)_3$] aiming to obtain a homogeneous co-formed metal oxides. In the second step, these oxides are heated up to a desired temperature and kept in a reductive flow of hydrogen, leaving the CuNiCo alloy as final product. The applied reduction temperatures were 300ºC and 900°C. The materials obtained after each step were characterized by Scanning Electron Microscopy (SEM) and Energy Dispersive X-Ray Detector (EDS). As result of the first step, it was found that oxygen, Cu, Ni and Co were, as desired, homogeneously distributed, as shown in the SEM elemental mapping (Figure 1). The after reduction obtained material present different shape and particle size, depending on the applied reducing temperatures (Figure 2). The more circular and greater size observed at 900ºC confirms an increased sintering occurrence at higher temperature and the EDS results indicate the expected composition for Co, Ni and Cu (Figure 3). The initial results given by Transmission Electron Microscopy (TEM) have shown the presence of particles with spherical morphology and a homogeneous distribution of the elements, which are sharing the same crystal structure. Also, it was noted the presence of particles smaller than 100 nm in the CuNiCo alloy, as show in Figure 4 (bright and dark fields).

Images

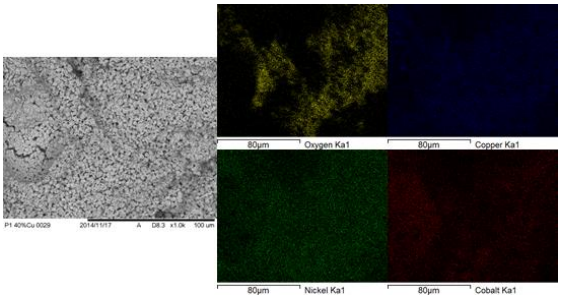


Figure 1. The SEM elemental mapping of co-formed oxides. X1000

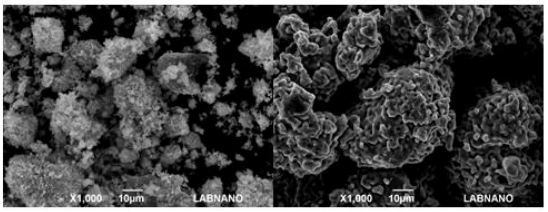
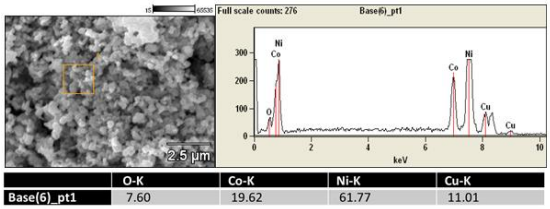


Figure 2. SEM images of CuNiCo alloy X1000. Reduction T a)300°C,b) T=900 °C



	O-K	Co-K	Ni-K	Cu-K
Base(6)_pt1	7.60	19.62	61.77	11.01

Figure 3. The EDS of CuNiCo alloy X10000. Reduction at T=300°C

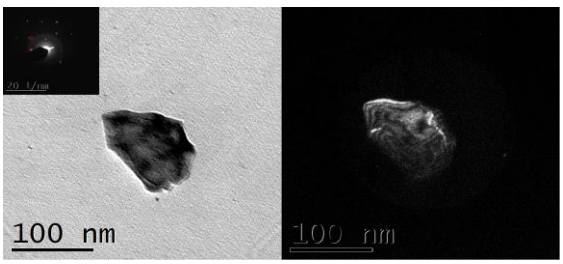


Figure 4. TEM observation of the alloy

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Biography
Eliana P Marin was a MSc student while Eduardo Brocchi and Guillermo Solorzano are professors, all at the Chemical and Materials Engineering Department, PUC-Rio, Brazil.