Synthesis of cobalt based magnetic nanoparticles using a modified Pechini Method

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Materials with magnetic properties have a wide variety of applications, and when they are nanostructured, may present even superior magnetic properties. Lately, there is a lot of research on the applications of cobalt based materials, mainly the cobalt ferrite, especially on medicine, where this ferrite could be applied on cancer treatment. The cobalt ferrite has a high electromagnetic performance and photomagnetism, high chemical stability and furthermore, studies indicate that it has biological compatibility in some cases. The main objective of this study was to produce magnetic nanoparticles based on cobalt using a variation of the Pechini Method. This method was chosen because its route of synthesis occurs in relatively low temperatures, reducing risks of contamination and loss of volatile components. The methodology consisted in the dissolution of cobalt nitrate and addition of citric acid at temperatures range between 60^{o}C to 70^{o}C. Then, the iron nitrate could or not be added, resulting later in CoO or cobalt ferrite ($CoFe_2O_4$) nanoparticles. After the complete dissolution of the metal citrate that was formed, ethylene-glycol was added and the temperature was increased to values ranging 90^{o}C to 110^{o}C, thus leading to the esterification of the solution. The resulting gel was dried in a muffle, at 110^{o}C for 24 hours, to remove the excess of water. After drying, the samples were calcined at 300^{o}C for 2 hours. The resulting material was milled obtaining a powder which was calcined for 2 hours (at different temperatures used for different samples in range from 650^{o}C to 950^{o}C). The structure of the resulting material was analyzed by X-Ray Diffraction and its nanometer surface was confirmed by scanning electron microscope. Through this characterizations the obtention, as major component, the desired phase (CoO or $CoFe_2O_4$) in nanometer scale was confirmed.
Keywords: Cobalt Nanoparticles, Modified Pechini Method, X-Ray Diffraction