Study on oxidation layer of single core Nickel nanobeads

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Magnetic separation is one of the technological applications of magnetic nanoparticles (MNP). Magnetic separation of organic compounds, proteins, nucleic acids and other biomolecules and cells from complex reaction mixtures is becoming the most suitable solution for large production in bioindustrial purification and extraction processes. Optimal magnetic properties can be achieved by the use of metals like nickel, instead of commercial magnetic nanobeads with unclear magnetic behaviour and high cost. However, they are extremely sensitive to oxidation and degradation under atmospheric conditions.

Ni nanoparticles (NPs) were synthesised by conventional solution reduction process. The obtained NPs were surfacted in citric acid and then coated with silica to form single core Ni nanobeads. In this work, the research is focused on the study of surfacted nickel NPs, since they have suffered oxidation before silica coating.

The surfacted nickel nanoparticles were characterized by Atomic Force Microscopy (AFM). Later, citric acid was removed to observe shape and size of nickel oxidated NPs with High Resolution Transmission Electron Microscopy (HRTEM) and determine morphology and structure of oxidation layer by means of Electron Energy Loss Spectroscopy (EELS) [1]

The nickel nanoparticles were polycrystalline with an average size of 50nm. The presence of nickel oxide superficial layer was confirmed by the elemental ratio between Ni and O observed in the EEL spectra [2] and by the FFTs of HRTEM images. EEL spectra along one particle showed that the layer of nickel oxide was not continuous and the thickness was not homogenous. To confirm this, a map of NiO and Ni distribution in a whole particle was obtained through multiple linear least-squares (MLLS) method fitting of a spectrum in cross section geometry.

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References

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