Magnetic and microwave properties of $Fe_{20}Ni_{80}$ magnetic nanoparticles with close to zero magnetostriction

Galina Kurlyandskaya[1], Igor Beketov[2,3], Satindar Bhagat[4], Alexander Safronov[2,3], Anatoly Medvedev[2], Aitor Larrañaga[1]

[1]Universidad del País Basco UPV-EHU, Spain

[2]Ural Federal University, Russia

[3]Institute of Electrophysics, Russia

[4]University of Maryland, USA

Iron-nickel alloys have been the subject of theoretical and experimental research. Fe-Ni nanoparticles (MNPs) with different composition are of special interest in the field of microwave applications. At the same time Fe–Ni alloys phase diagram is a fundamental subject still poorly developed for MNPs. Fe–Ni diagram can be divided into characteristic parts with respect to MNPs crystallographic structure: body-centered cubic system (bcc), face-centered cubic system (fcc) and bcc plus fcc coexistence region [1]. At room temperature coexistence bcc + fcc region depends critically on the preparation technique. In our previous studies we have analyzed pure iron, nickel MNPs, FeNi MNPs with $Fe_{45}Ni_{55}$ and $Fe_{64}Ni_{36}$ compositions prepared in particular conditions of electrical explosion of the wire (EEW) technique [2]. One very important part of EEW Fe–Ni alloys phase diagram is still missing in the literature, MNPs of $Fe_{19}Ni_{81}$ composition, corresponding to close to zero magnetostriction. In this work we have prepared Fe–Ni MNPs of $Fe_{19}Ni_{81}$ composition by the electrical explosion of wire employing controlled variation of explosion parameters for the synthesis. Their structure, morphology, magnetic and microwave properties were studied by different techniques. Figure 1 shows example of selected parameters for spherical $Fe_{19}Ni_{81}$ EEW MNPs with specific surface of 5.3 m^2/g, being pure fcc phase as confirmed by X-ray diffraction studies.

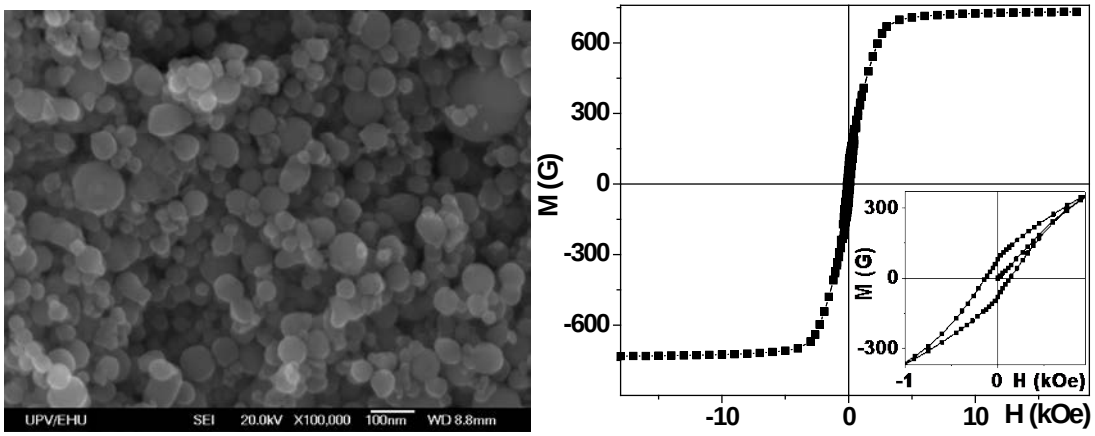

Figure 1. Spherical $Fe_{19}Ni_{81}$ EEW MNPs: scanning electron microscopy image of (left); magnetic hysteresis loop with primary magnetization curve, inset shows low field part (right).

[1] L.J. Swartzendruber, V.P. Itkin, C.B. Alcock, J. Phase EquilIb.12 (3) (1991) 288–312.
[2] G.V. Kurlyandskaya, I. Madinabeitia, I.V. Beketov, A.I. Medvedev, A. Larrañaga, A.P. Safronov, S.M. Bhagat, J. Alloy.Comp. 615 (2014) S231–S235.