Abstract

We have produced samples of Fe_xCu_{100-x} and Fe_xAu_{100-x} by mechanical alloying in varying concentrations with the purpose of study the Giant Magnetoresistance Effect and its relationship with their microstructure in alloys prepared with such technique. We have done on the Fe_xCu_{100-x} system a study of the giant magnetoresistance effect in a wide range of concentrations ($1 \leq x \leq 45$ atomic %), spanning the knowledge about Fe-Cu alloys prepared for the same purpose. We have produced Fe-Au alloys by mechanical alloying for the first time, in different concentrations ($15 \leq x \leq 30$ atomic %). We measured the magnetoresistive effect at 77 K for every concentration. We found that the maximum effect occurs at x = 20 % for Fe-Cu alloys, and at x = 25 % for Fe-Au alloys. We have not found effect at room temperature. From the structural point of view we found that in both systems a solution with the matrix fcc structure (Cu or Au) is formed. Lattice parameter increases with concentration in the Fe-Cu alloys, while decreases in the Fe-Au alloys. Lattice parameter differs, in both cases, from the Vegard´s law expected values, showing that chemical-repulsive effects are important in these systems. Boths systems belongs to the cluster-glass type of magnetism, with a percolation threshold $C_p = 15,9 \pm 3,2$ atomic % for the Fe-Cu alloys, and $C_p \approx 25$ at. % in the case of Fe-Au alloys. Fe-Cu system consists in a dispersion of clusters of 2 nm in size, with similar structural and magnetic properties for all the studied concentrations. Thermal treatments produce an enhancement of the magnetoresistive ratio $\Delta\rho/\rho$, but in the effect $\Delta\rho$. It worsens in Fe-Cu alloys, and not changes in Fe-Au alloys. In the Fe-Cu system this treatment favours α- and γ- Fe precipitation, and carbides formation. As a consequence of thermal treatments Fe enrichment in the clusters is produced in Fe-Au alloys, besides a precipitation of a ferromagnetic component. Both systems are formed by strongly-interacting particles. Mechanical alloying is a suitable technique for the fabrication of Fe-noble metals giant-magnetoresistive systems.