

STUDY OF THE FORMATION, SINTERING AND PROPERTIES OF Fe_xCo_y AND (FeCo)-Ag OBTAINED BY MECHANICAL ALLOYING

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Mechanical Alloying is a process in which a blend of elemental compound powders is subjected to highly compressive impact forces. The process involves fracture, welding, heavy deformation and creation of defects. The intense deformation accelerates interdiffusion and the large defects densities favors the chemical and physico-chemical transformations taking place during this process. A reduction in grain size to nanometric scale is also obtained by this process. Milling is carried out a room temperature under inert atmosphere^[1].

In the present work, the formation by mechanical alloying of Fe_xCo_y system and their alloying with Ag was studied. Also the sinterization behavior and hardness properties of these alloys were considered and the microstructure-properties relationship was analyzed. The process of alloy formation and its miscibility with Ag was followed by x-ray diffraction (XDR) and the reduction on grain size with milling was determined using the Scherrer equation and by transmission electron microscopy(TEM). The material consolidation by sintering was followed by scanning electron microscopy (SEM) and EDS analysis. Microhardness measurements (Vickers) were performed on all the alloys.

The experimental procedure was divide in three stages: the first stage is the study of the alloy formation with milling, in a high energy Spex mill 8000, during 1, 3, 5, 10 and 25 h for Fe_xCo_y with atomic ratios of 50:50, 70:30 and 30:70. These alloyed powders were further mixed with Ag in atomic proportions of 5, 20 and 60% and milled for 10 h. The second stage, corresponds to the sinterization thermal treatment of all the alloys. And the third stage was the evaluation of the mechanical properties (Vickers microhardness) of the samples, with the aim to establish a structure- properties relationship.

Fig. 1 and Fig.2 show the microstructure of some of these alloys milled and sintered. In Fig. 1a the TEM image of the $\text{Fe}_{50}\text{Co}_{50}$ alloyed powder after milling for 25 h can be observed. The average grain size is 10-20nm in very good agreement with that measured by Scherrer equation.

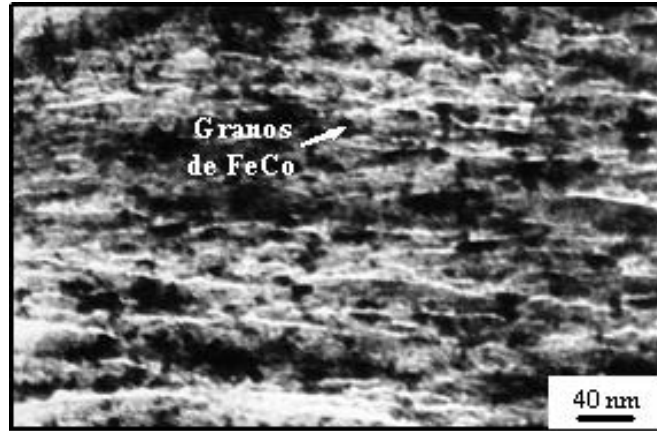
Sintering resulted in relative good particle consolidation and grain growth. The systems alloyed with Ag showed complete immiscibility, specially after sintering. However, Ag seems to favor porosity decrease in all the compositions studied and also provides protection against oxidation.

Fig. 2 shows the SEM micrographs of the sintered $(\text{Fe}_{70}\text{Co}_{30})_{80}\text{-Ag}_{20}$ and $(\text{Fe}_{50}\text{Co}_{50})_{40}\text{-Ag}_{60}$. The microstructure is formed by islands of the FeCo compound surrounded by Ag. This microstructure is promising for magnetic properties

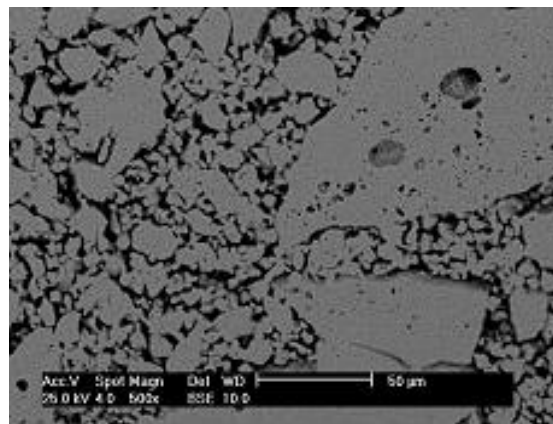
The measurements of microhardness show the $\text{Fe}_{50}\text{Co}_{50}$ compound to have the highest value of the three alloys. Ag addition decreases hardness as expected due to its high ductility.

Referentes

[1] N.S Cohen et al. J. Physics, Vol. 11 (1999) pp. 8839-8853.

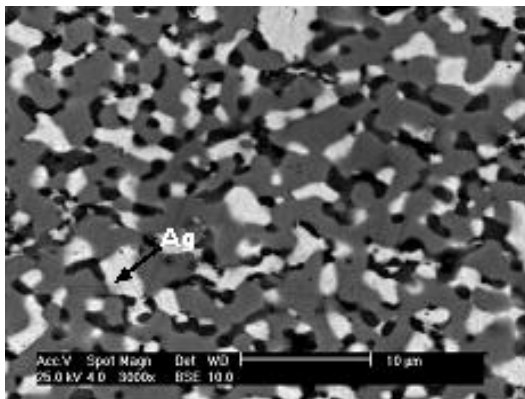


(a)

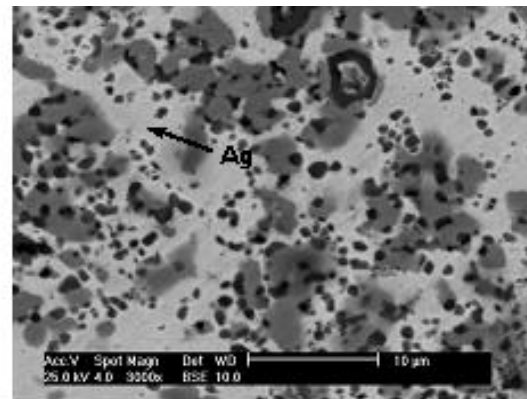


(b)

Fig. 1 Photomicrographs of $\text{Fe}_{50}\text{Co}_{50}$ alloy: (a) TEM bright field image of the alloyed powder milled for 25 h (b) SEM image of the sintered alloy at $950\text{ }^{\circ}\text{C}$ for 1h



(a)



(b)

Fig. 2 SEM photomicrographs of sintered samples of alloys: (a) $(\text{Fe}_{70}\text{Co}_{30})_{80}\text{-Ag}_{20}$ and (b) $(\text{Fe}_{50}\text{Co}_{50})_{40}\text{-Ag}_{60}$