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EXAFS analysis of local environments around Fe and Co sites in Fe-Co alloys

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Abstract – Local structure around Fe and Co sites in the melt-quenched $Fe_{0.5}Co_{0.5}$ and $Fe_{0.7}Co_{0.3}$ alloys was studied by extended x-ray absorption fine structure (EXAFS) technique. EXAFS analysis (Fe and Co K-edges) reveals the presence of two bcc structures: the first one is associated to an equiatomic chemically ordered FeCo phase while the second one is associated to a disordered phase. Mössbauer and SQUID measurements show that although the magnetic moment of Fe in the $Fe_{0.5}Co_{0.5}$ alloy is less than the corresponding value for the $Fe_{0.7}Co_{0.3}$ alloy, it shows a better magnetic ordering as compared to the second one.

Soft magnetic materials, such as Fe-Co alloys, play an important role in various technological applications that operate at high temperature [1]. There is a renewal interest to study these alloys, particularly those useful for the development of new nanostructured materials such as HITPERM, in which the Fe-Co alloys are part of the microstructure [2,3].

In this work, the local structure around Fe and Co sites in $Fe_{0.5}Co_{0.5}$ and $Fe_{0.7}Co_{0.3}$ alloys was studied by extended x-ray absorption fine structure (EXAFS) technique. Both samples were prepared by arc furnace, subsequently annealed at 900 °C in evacuated quartz tubes for up to 96 h and then liquid-nitrogen quenched. Magnetic properties were investigated using Mössbauer spectroscopy and SQUID.

EXAFS oscillation curves for the Fe and Co K-edges for both samples were fitted with the calculated ones for the bcc structure. The corresponding analysis reveals the presence of two bcc structures: the first one is associated to an equiatomic chemically ordered FeCo phase (α) while the second one is associated to a disordered phase (α'). This analysis is consistent with x-ray diffraction results. Moreover, EXAFS studies within the first coordination shells in these crystalline samples support the model of two co-existing phases (about 50% of each one).

^{57}Fe Mössbauer and magnetization measurements show that although the magnetic moment of Fe in the $Fe_{0.5}Co_{0.5}$ alloy is less than the corresponding value for the $Fe_{0.7}Co_{0.3}$ alloy, it shows a better magnetic ordering as compared to the second one.

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