ANALYSIS OF CLUSTERIZATION AND NANOCRYSTALLIZATION EFFECTS IN POTENTIODYNAMIC PASSIVATION OF FINEMET TYPE ALLOYS IN KOH SOLUTIONS

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The roles of Cu and Nb additions in nanocrystallization have been the subjet of many investigations. During heat treatment of Fe73.5Cu1Nb3B9Si13.5 alloys (FINEMET alloys), Cu atoms segregate and act as nucleation centres. The spatial distributions of the Cu-enriched clusters were observed directly by the three-dimensional atom probe (3DAP) technique [1]. The additiion of Nb or other slowly diffusing components such as Ta, V and W restricts the growth of the crystals wich in turn reduces grain size. Using atom-probe field ion microscopy (APFIM), Hono et al. [2] reported that the niobium and boron are rejected from the Fe-Si primary particles and partitioned in the remaining amorphous phase. Since the enrichment of Nb and B stabilizes the remainning amorphous phase, it suppresses the growth of the FeSi primary crystals.

The Kinetics of copper clustering and primary crystallization of FINEMET type alloys was studied by small-angle neutron scattering (SANS) and high–sensitivity differential scanning calorimetry (DSC) [3], in order to explain the different optimized Cu contents for obtaining the highest permeability in these alloys. M. Ohnuma et al. observed that the size and distribution of the Fe-Si grains in the final microstructure are strongly influenced by the kinetics of Cu clustering.

The introduction of nanocrystalline heterogeneity in metallic amorphous alloys affects their corrosion resistance, depending upon the change in the composition of matrix phase and the size and type of the precipitates [4, 5]. Although the presence of nanocrystallinity greatly affects the corrosion resistance, alloys with nanocrystallites smaller than a certain critical size can be regarded as homogeneus alloys and sometimes show better corrosion resistance than their amorphous counterparts [6].

The present work aims to study the corrosion behaviour of clustered and nanocrystalline FINEMET type alloys developed by heat treatment of the amorphous samples. Amorphous alloy ribbons of about 10 mm wide and 20-30 μm thick were prepared by planar flow casting method. The amorphous structure of the samples was verified by X-ray diffraction. The kinetics of Cu clustering have been investigated by DSC, according to the Ohnuma method [4]. DSC measurements were carried out on a DSC 2920 instrument (TA Instruments) with a N_2-gas DSC cell purge. The corrosion behaviour of clustered and nanocrystalline samples was studied by DC electrochemical thecniques. During the electrochemical measurements the electrode potentials were controlled with a Princeton Applied Research (PAR) Model 273 potentiostat. The results suggested that the spatial distribution, and the size of Cu clusters, influence the final microstructures of FINEMET TYPE alloys, and so, their corrosion behaviour.

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