MÖSSBAUER STUDY OF Fe-Zr AMORPHOUS ALLOYS HYDROGENATED AT DIFFERENT CATHODIC POTENTIALS

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Mössbauer spectroscopy was used for studying the effect of hydrogenation on amorphous Fe$_{90}$Zr$_{10}$ and Fe$_{90}$Zr$_{11}$ alloys electrolytically charged to high hydrogen content. The differences observed between the room temperature Mössbauer spectra of uncharged and hydrogenated amorphous alloys can be attributed to a change in the Curie temperature. Up to a certain hydrogen content the Curie temperature increases with the hydrogen concentration while the Curie temperature goes thorough a maximum as the hydrogen content increases.

Introduction

Recently the hydrogenation of amorphous Fe-Zr alloys has been extensively studied by means of Mössbauer spectroscopy /1-8/. An increase of the Curie temperature was observed by Mössbauer spectroscopy in Fe$_{90}$Zr$_{10}$/1-2/ and in Fe$_{90}$Zr$_{11}$/3-5/ alloys as an effect of hydrogenation. In our previous work /5/ we established that the dependence of Curie temperature on hydrogen concentration has a maximum.

The aim of the present work was to get further information about the effect of hydrogenation in Fe$_{90}$Zr$_{10}$ and Fe$_{90}$Zr$_{11}$ amorphous alloys charged with hydrogen to various concentrations.

Experimental

Amorphous alloys Fe$_{90}$Zr$_{10}$ and Fe$_{90}$Zr$_{11}$ prepared in the form of rapidly quenched ribbon about 20 μm thick were electrolytically hydrogenated in 0.01 mol/dm$^3$ HClO$_4$ + 0.99 mol/dm$^3$ NaClO$_4$.H$_2$O. The DC current was supplied by a potentiostat. Electrode potentials are given relative to the standard hydrogen electrode. Different hydrogen contents were achieved at different cathodic potentials.

The amorphous state of hydrogenated samples was checked by X-ray diffractometry. No sign of crystallisation was observed in the samples hydrogenated up to -1000 mV cathodic potential.

The quantity of hydrogen in the charged sample was measured by weighing the samples before and after hydrogenation as well as by gas chromatography.

In order to effuse hydrogen, the hydrogenated sample was subjected to heat treatment at 150 °C in Ar atmosphere. Another way of hydrogen effusion was realized by keeping the precharged samples in the electrolyte after switching off the electric current.

The transmission spectra were taken at room temperature and
at the temperature of liquid nitrogen. CEM spectra were recorded at room temperature. 2x10^7 Bq ^{97}Co source in Rh matrix provided gamma-rays. Isomer shifts are given relative to alpha-iron. The magnetic field distributions were obtained by Fourier analysis with the same program as used in /9/.

Results and discussion

The room temperature Mössbauer spectra of moderately hydrogenated alloys (charged at -500 mV cathodic potential) were magnetically split while the original alloy showed paramagnetic spectrum lines (Fig. 1). Up to -750 mV cathodic potential a well resolved magnetically split spectrum can be seen, but the average hyperfine field slightly decreases with increasing hydrogen content. At higher hydrogen concentration the magnetic splitting gradually begins to collapse, the spectrum (of the sample hydrogenated at -1000 mV) has large central components (Fig. 2/b). At still higher hydrogen concentration (at -1250 mV cathodic potential) the sextet of alpha-iron appears in the room temperature Mössbauer spectrum (Fig. 2/c), while the other ferromagnetic spectrum part is very similar to that recorded with samples of lower hydrogen content (e.g. -500 mV). Moreover, at the temperature of liquid nitrogen no paramagnetic

![Fig.1. Room temperature Mössbauer spectra of the Fe_{28}Zr_{72} amorphous alloy: (a) as-quenched, (b) after charging at -500 mV](image1)

![Fig.2. Room temperature Mössbauer spectra of the Fe_{28}Zr_{72} amorphous alloy charged at -750 mV (a), -1000 mV (b) and -1250 mV (c)](image2)