

Nanostructured Surfaces

Morphology and Electronic Structure of the Amorphous Metal Alloy $\text{Fe}_{77}\text{Si}_8\text{B}_{15}$ Surface at Thermal Effect

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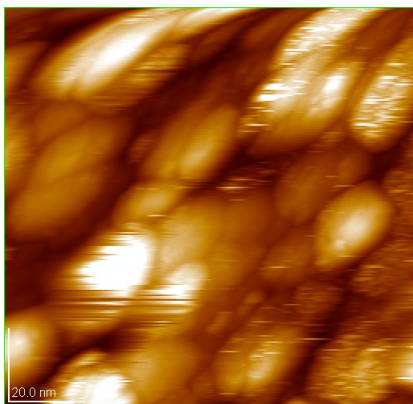


Scanning tunneling microscopy and spectroscopy methods were used to study the relaxation processes on the surface of amorphous tapes of $\text{Fe}_{77}\text{Si}_8\text{B}_{15}$ depending on the annealing and cooling temperatures. The effects of temperature and rate of heating on the surface morphology and nanocrystals size were shown. Investigated samples of amorphous tape were produced by rapid cooling of the melt composition $\text{Fe}_{77}\text{Si}_8\text{B}_{15}$,

annealed for one hour at temperatures from 300 °C to 600 °C (Fig. 1) by direct current heating in a vacuum chamber of the microscope. The residual pressure during annealing process was not higher 10^{-7} Pa.

It was found that the annealing process at the tape surface leads to formation of nanocrystalline phase of α -Fe or α -Fe (Si) located in an amorphous matrix, what is caused by a local stabilization of the amorphous structure.

During fast annealing at low temperatures was found formation of nanoclusters with close to spherical surface



20 nm morphology. Such morphology of clusters is most optimal in terms of achieving the desired soft magnetic properties of amorphous tapes. Observed nanocrystals at moderate annealing temperatures have size of about 15 nm what is comparable with the length of magnetic exchange correlation. The distribution of the average cluster size like that leads to a spatial averaging of the magnetic anisotropy and, consequently, to a significant decrease in the coercive force.

Depending on the local atomic ordering, what has an impact on the process of

Fig. 1. The surface of the amorphous tape annealed at 600 °C.

nucleation of nanocrystals, the small areas separated by an amorphous phase forms in the early stages of crystallization and then consolidates with subsequent increase of temperature and time of annealing.