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뫼스바우어 분광방법을 이용한 볼밀링에 의한 Fe-Zr 비정질 합금의 결정화에 관한 연구

BALL-MILLING INDUCED CRYSTALLIZATION OF Fe-Zr AMORPHOUS ALLOYS: THE MOESSBAUER SPECTROSCOPY STUDY

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The structural evolution of an amorphous $Fe_{90}Zr_{10}$ alloy under high-energy mechanical deformations was investigated by means Moessbauer spectroscopy along with X-ray diffraction and magnetic measurements. Milling of melt-spun $Fe_{90}Zr_{10}$ ribbons in a planetary ball mill (AGO2) induces their crystallization into supersaturated alpha-Fe(Zr) grains. The decomposition degree of the amorphous phase increases with increasing milling time, with a fully crystalline state being obtained after 30 min at a milling speed of 1000 rpm. The Zr content of the Fe grains reaches a maximum of about 3 at.% after milling for 30 min. Moessbauer spectra and saturation magnetization measurements suggest that the remaining Zr atoms are most likely segregated at the grain boundaries. Analyses of samples milled at different speeds reveal that the decomposition degree of the amorphous phase is determined by the dose of mechanical energy supplied to the sample. As alpha-Fe(Zr) is also formed at low milling speeds, local temperature rises and impurity incorporation can be excluded as major causes of the crystallization process. It can be concluded that crystallization of amorphous $Fe_{90}Zr_{10}$ under ball milling is a deformation-induced process.