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Optical anisotropy of the ribbon skin-layer of Ni-based amorphous metallic alloys

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Multicomponent amorphous metal alloys with ferromagnetic properties are a class of optoelectronic materials with unique set of optical, mag-netic and electrical properties. An important problem is the diagnostics of elastic-stress state of amorphous ribbons after their production by rapidly quenched method. In this paper to characterize the elastic-stress state of the $Ni_{78}Si_8B_{14}$ ribbons the parameters of electronic subsystem of alloy, namely plasma ω_ρ and relaxation γ frequencies were used. These parameters were determined from azimuthal ellipsometric measurements by applying the functions $F_1 - F_3$ that are based on the Drude ratio. An ellipsometer in combination with a spectrometer ($\lambda = 2 - 25\mu m$) was used to study the optical properties of $Ni_{78}Si_8B_{14}$ ribbons. As a result of the ellipsometric measurements we have obtained the spectral dependenes of the real ϵ_1 and imaginary ϵ_2 parts of the complex dielectric constant of the $Ni_{78}Si_8B_{14}$ ribbons at different values of the azi-muthal angle α, latter determines the orientation of the longitudinal axis of the ribbon according to the incident light plane.
It was found that the plasma and relaxation frequencies of the amorphous $Ni_{78}Si_8B_{14}$ alloy are decreasing with the gradual azimuthal rotations of the ribbon in its own plane. This means that the number of free electrons becomes less with increasing mobility of charge carriers. Such behaviour of the electronic and optical properties of the skin-layer of the $Ni_{78}Si_8B_{14}$ ribbons is a consequence of presence of the deformations and elastic stresses that occur on both sides of the Ni-based alloy ribbon due to specific thermal conditions during its manufac-ture. It was found that formation of nanocrystals within subsurface layer of the ribbon makes an additional contribution to the revealed optical anisotropy of amorphous ribbon.

Key words: amorphous ribbons, ellipsometry, optical properties, electronic parameters

Topics

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