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Magnetoelastic Effect of 316LN-IG Stainless Steel at Low Temperatures

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Uniaxial tensile tests of 316LN-IG stainless steel specimens cut along the axis of tubes were performed in liquid and gaseous helium below 8 K. Time dependences of stress, temperature, strain and strain induced magnetization normal to the specimen surface were studied. A complicated behavior of the local deformation near slip bands observed earlier [Tech. Phys. 57 (2012) 1562] was verified, namely, regions close to slip bands are unloaded and shrink at the moment of strain jump. Simultaneous measurements of strain and magnetization showed that the γ phase has negative longitudinal magnetostriction. In the region of elastic strain the magnetic field normal to the specimen surface was detected. It changed in proportion to the strain up to 0.3 mT at the relative strain of 0.7%. When changing from the elastic strain to the plastic one, as the magnetic α phase arose, the strain induced magnetic field decreased slightly, presumably, due to its screening by the α phase. Further strain dependence of the magnetic field, in the region of intensive formation of the α phase, indicated a negative longitudinal magnetostriction for the α phase, like for the γ phase. The strain jumps without any local heat release found earlier [1] can be explained from the point of view of the magnetoelastic effect observed. Lack of the local heating can result from the magnetocaloric effect in the regions unloaded and shrunk at the moment of a strain jump. Such situation is possible if the energy needed for adiabatic reorientation of magnetic moments when the stress drops is comparable with the heat release by the strain jump.

[1] A.V. Krivykh, O.P. Anashkin, D.N. Diev, V.E. Keilin, A.V. Poliakov, V.I. Shcherbakov. Proc. Int. Sci.-Tech. Conf. Nanotechnologies of Functional Materials (NFM'12), 27-29 June, 2012, St.-Petersburg, Russia, 235 (in Russian)

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