The effect of alloying with Mn on physical properties of Cu-Al-Mn alloys after thermomagnetic treatment

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Recently, an attention of researchers is focused on studying of functional materials with restructuring of martensitic type in which a reversible changing in size under the influence of temperature, applied external stress, magnetic fields or combining them takes place and the effects of shape memory, pseudoelasticity (superelasticity), transformation plasticity, magnetoelastic deformation and etc. occur. Such materials find wide application as actuating mechanisms, actuators, sensors and others.

Aging Cu-Mn-Al alloys undergo thermo-induced martensitic transformation (MT) as well. Such type of MTs which occur after solid solution decomposition with ferromagnetic nanoparticles precipitation in nonferromagnetic matrix attract interest. By thermal treatment, the system of ferromagnetic nano-dispersed particles in nonferromagnetic matrix can be formed. Herewith, coherent nanoparticles precipitated during decomposition of high-temperature Cu-Al-Mn β_1-phase are coherently connected with matrix and do not undergo spontaneous MT at cooling.

In this work, the influence of alloying with Mn as well as regimes of aging of high-temperature phase on subsequent martensitic transformation in Cu-Al-Mn alloy was studied. The morphology of martensitic transformation behaviour as a result of alloy aging under an annealing in a constant magnetic field with different sample orientation relatively to the field and without the field was investigated in order to directly control the process of martensite induction at cooling. The temperature dependences of electrical resistance, magnetic susceptibility, and the temperature and field dependences of magnetization were found. The alloys phase composition and microhardness were determined. The tendency of oriented growth of the precipitation-phase particles in a direction of applied field and the increase of volume fraction of these particles under thermal magnetic treatment of material what favours a reversibility of induced martensitic transformation.