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Thermomechanical Treatments and Thermoresponsive Reactions in Shape Memory Alloys

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A series of materials take place in class of advanced smart materials with adaptive properties and stimulus response to the external changes. Shape memory alloys take place in this group, due to the shape reversibility and capacity of responding to changes in the environment. These alloys exhibit a peculiar property called shape memory effect, which is characterized by the recoverability of two certain shapes of material at different temperatures. Shape memory effect is initiated by thermomechanical cooling and stressing treatments on the material and performed thermally on heating and cooling. This behavior can be called thermoelasticity. These alloys have dual characteristics called thermoelasticity and superelasticity, from viewpoint of memory behavior. Two successive structural transformations, thermal and stress induced martensitic transformations govern shape memory phenomena in crystallographic basis. Thermal induced martensitic transformation occurs with the cooperative movement of atoms in 110>- type directions on {110}-type planes of austenite matrix, by means of shear-like mechanism, and ordered parent phase structures turn into twinned martensite structures. Stress induced martensitic transformations occur along with crystal or lattice detwinning reaction by stressing material in low temperature condition, and twinned structures turn into detwinned martensite structures. Upon cooling after these treatments, detwinned martensite structures turn into ordered parent phase structure by means of reverse austenite transformation. Superelasticity is performed by stressing and releasing material at a constant temperature in parent phase region, and shape recovery is performed simultaneously upon releasing the applied stress. Copper based alloys exhibit this property in metastable β-phase region. Lattice invariant shear is not uniform in copper-based shape memory alloys, and cause to the formation of long-period layered martensitic structures with lattice twinning on cooling. The long-period layered structures can be described by different unit cells as 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice. In the present contribution, electron diffraction and x-ray diffraction studies performed on two copper based CuZnAl and CuAlMn alloys. Electron diffraction patterns and x-ray diffraction profiles exhibit super lattice reflections in martensitic condition. Specimens of these alloys aged at room temperature in martensitic condition, and a series of x-ray diffractions were taken duration aging at room temperature. Reached results show that diffraction angles and peak intensities change with aging time at room temperature. Specially, some of the successive peak pairs providing a special relation between Miller indices come close each other, and this result refers to the rearrangement of atoms in diffusive manner.

Biography

Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He has studied at Surrey University, Guildford, UK, as a post doctoral research scientist in 1986-1987, and studied on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980.