**Lattice Reactions Governing Martensitic Transformation in Shape Memory Alloys**

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Some 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, by exhibiting a peculiar property called shape memory effect, which is characterized by the recoverability of two certain shapes of material at different conditions. These alloys have dual characteristics called thermoelasticity and superelasticity, from viewpoint of memory behavior. Shape memory effect is initiated on cooling and deformation and performed thermally on heating and cooling. Therefore, this behavior can be called thermoelasticity. Superelasticity is performed mechanically by stressing and releasing material in elasticity limit at a constant temperature in parent phase region, and shape recovery is performed simultaneously upon releasing the applied stress. Superelasticity is performed in non-linear way; stressing and releasing paths are different in the stress-strain diagram, and hysteresis loop refers to energy dissipation. These items are governed by martensitic transformations. Thermoelasticity is governed by thermal and stress induced martensitic transformations. These transformations are governed by lattice twinning and detwinning reactions in crystallographic level. Thermal induced martensite occurs along with crystal twinning in self-accommodating manner on cooling and ordered parent phase structures turn into twinned martensite structures. The twinned structures turn into detwinned martensite structure along with detwinning reaction with deformation, by means of stress induced martensitic transformation. Superelasticity is result of stress induced martensitic transformation and ordered parent phase structure turns into detwinned martensitic structure with stressing in parent phase region. Thermal induced martensitic transformation is lattice-distorting phase transformation occur with the cooperative movement of atoms on {110} -type planes of austenite matrix, by means of lattice invariant shear. Copper based alloys exhibit this property in metastable phase region, which has bcc-based structures at high temperature parent phase field. Lattice invariant shear and lattice twinning is not uniform in these alloys, and cause to the formation of long-period layered martensitic structures, like 3R, 9R or 18R structures depending on the stacking sequences, with lattice twinning.

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, and this result refers to the rearrangement of atoms in diffusive manner.

**Keywords:** Shape memory effect, martensitic transformation, thermoelasticity, superelasticity, lattice twinning, detwinning.

**Biography of presenting author**

Dr. 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 were focused on shape memory effect in shape memory alloys. His academic life started following graduation by attending an assistant to Dicle University in January 1975. He became professor in 1996 at Firat University in Turkey, and retired on November 28, 2019, due to the age limit of 67, following academic life of 45 years. He supervised 5 PhD- theses and 3 M. Sc- theses and published over 80 papers in international and national journals; He joined over 120 conferences and symposia in international level with contribution. He served the program chair or conference chair/co-chair in some of these activities. Also, he joined in last six years (2014 - 2019) over 60 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. Additionally, he joined over 70 online conferences in the same way in pandemic period of 2020-2021. Dr. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University, in 1999-2004. He received a certificate awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

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