**Temperature - Deformation Dependent of Shape Reversibility in Shape Memory Alloys**

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**Abstract:**

Heat treatment, homogenization and phase transformations have great importance in the processing of materials as a tool in industry and other fields. Shape memory effect is a temperature dependent phenomenon exhibited by certain alloy systems called shape memory alloys. These alloys have dual characteristics called thermoelasticity and superelasticity. Thermoelasticity is governed by the thermal and stress induced martensitic transformations on cooling and stressing and performed thermally on heating and cooling after first cooling and stressing processes. Therefore, this behavior is called Thermoelasticity. Superelasticity is governed by stress induced transformation by stressing and releasing materials at a constant temperature in parent phase region. Shape memory alloys can be plastically deformed with external stress in the low temperature product phase condition and recover the original shape on heating, and cycle between original and deformed shapes in reversible way, on cooling and heating, respectively. This phenomenon involves a crystallographic phase transformation, martensitic transformation, on cooling and reverse austenitic transformation on heating. Thermal induced martensite occurs along with lattice twinning and ordered parent phase structures turn into twinned martensite structures by means of lattice invariant shears, and these structures turn into detwinned martensitic structures by means of stress induced transformation. Lattice twinning occurs in two opposite directions, <110 > -type directions on the {110}-type plane of austenite matrix in self-accommodating manner and consists of lattice twins. Temperature has great importance in the thermomechanical behavior of these alloys. Shape memory effect is performed in a temperature interval after first cooling and stressing processes, whereas superelasticity is performed mechanically in a constant temperature in parent phase region, just over the austenite finish temperature. Deformation at different temperature exhibits different behavior beyond shape memory effect and superelasticity. Copper based alloys exhibit this property in metastable beta-phase region, which has bcc-based structures at high temperature parent phase field. Lattice invariant shear is not uniform in copper-based alloys and cause the formation of complex layered structures, depending on the stacking sequences on the close-packed planes of the ordered lattice.

In the present contribution, x-ray and electron diffraction studies were carried out on two solution treated copper based CuZnAl and CuAlMn alloys. Electron and x-ray diffraction exhibit super lattice reflections. Specimens of these alloys were aged at room temperature, at which both alloys are in martensitic state, and a series of x-ray diffractions were taken at different stages of aging in a long-term interval. X-Ray diffraction profiles taken from the aged specimens in martensitic conditions reveal that crystal structures of alloys chance in diffusive manner.

**Key words:** Shape memory effect, martensitic transformation, thermoelasticity, superelasticity, twinning and detwinning

**Biography**

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 on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980. He became professor in 1996, and he has already been working as professor. He published over 80 papers in international and national journals; He joined over 100 conferences and symposia in international and national level as participant, invited speaker or keynote speaker with contributions of oral or poster. He served the program chair or conference chair/co-chair in some of these activities. In particular, he joined in last seven years (2014 - 2020) over 80 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. He supervised 5 PhD- theses and 3 M.Sc.- theses. 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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