# Nanoscale aspects of shape memory effect and reversibility in shape memory alloys

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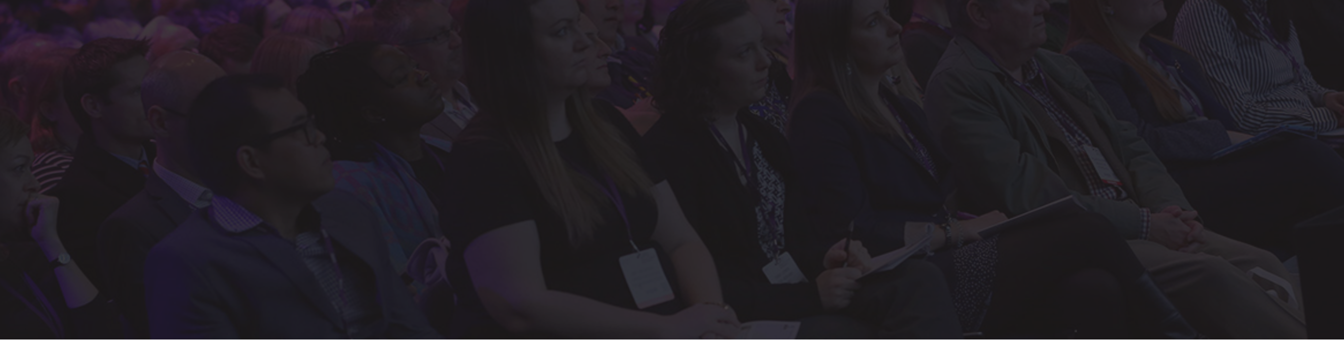
A series of alloy systems take place in a class of adaptive structural materials called smart materials by giving stimulus response to changes in the external conditions. Shape memory alloys take place in this group by exhibiting a peculiar property called shape memory effect. These alloys have ability to recover original and deformed shapes on heating and cooling after first cooling and deformation processes. Shape memory effect is facilitated by successive crystallographic transformations in nanoscale level by which crystalline structure of the material change. These transformations are thermal and stress induced martensitic transformations and governed by two lattice reactions, lattice twinning and detwinning. Thermal induced transformations occur thermally along with lattice twinning by means of lattice invariant shear on cooling, and the twinned martensite structures turn into detwinned structures by means of strain induced martensitic transformation by straining the material plastically in martensitic condition. Strain energy is stored in the material by deformation and released on heating over austenite finish temperature recovering the original shape, and material cycles reversible between the deformed and original shapes on cooling and heating. Thermal induced martensitic transformations occur with cooperative movement of atoms in <110> -type directions on {110} - type planes of austenite matrix which is basal plane of martensite. Superelasticity is another characteristic of shape memory alloys and performed by stressing and releasing the material in parent phase region. Loading and unloading paths are different in stress strain diagram, and cycling loop reveals energy dissipation. The strain energy is stored after releasing, and these alloys are mainly used as deformation absorbent materials in control of civil structures subjected to seismic events, due to the absorbance of strain energy during any disaster or earthquake. Copper based alloys exhibit this property in metastable β-phase region, which has bcc-based structures at high temperature parent phase field. Lattice invariant shear and twinning is not uniform in copper based ternary alloys and gives rise to the formation of complex layered structures, depending on the stacking sequences on the close-packed planes of the ordered parent phase lattice. In the present contribution, x-ray diffraction and transmission electron microscopy (TEM) studies were carried out on two copper based CuAlMn and CuZnAl alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections inherited from parent phase due to the displacive character of martensitic transformation. X-ray diffractograms taken in a long time interval show that diffraction angles and intensities of diffraction peaks change with the aging duration at room temperature. In particular, some of the successive peak pairs providing a special relation between Miller indices come close each other. This result refers to the rearrangement of atoms in diffusive manner.



**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 60 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 five years (2014 - 2018) over 50 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 for 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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