International Journal of Innovative Research in Science, Engineering and Technology 2021, Vol.2, Issue 5 *Short Communication*

Temperature-Deformation Relations in Shape Memory Alloys

Adiguzel O

Ankara University, Turkey

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 thermal and stress induced martensitic transformations on cooling and stressing and performed thermally on heating and cooling after first cooling and stressing processes. 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. Shape memory effect 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. The twinning occurs with internal stresses, while detwinning occurs with the external stresses. Twinning and detwinning processes can be considered as elementary processes activated during the transformations. Temperature has great importance in the thermomechanical behavior of shape memory 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, and this result refers to the stabilization.

Note: This work is partly presented at 34th International Conference on Nanotechnology & Expo at November 15-16, 2019 | Madrid, Spain