Shape memory effect is an unusually property exhibited by certain alloy systems, and shape memory behaviour is evaluated on the basis of structural changes on unit cell level. Shape memory effect is based on a displacive transition, martensitic transformation, which causes to the changes in internal crystalline structure of materials. Copper based alloys exhibit this property in metastable β-phase region. These alloys transform martensitically from the high symmetry ordered structures to the low symmetry layered structures on cooling from high temperatures.

Martensitic transformations occur in a few steps with the cooperative movement of atoms less than interatomic distances by means of lattice invariant shears on a {110}-type plane of austenite matrix which is basal plane of martensite. Product phase in this transition has the unusual layered structure which consist of an array of close-packed planes with complicated stacking sequences called as 3R, 9R or 18R martensites depending on the stacking sequences on {110}-type planes of parent phase.

X-ray diffraction and electron diffraction studies were carried out on two copper based ternary alloys, CuZnAl and CuAlMn, at room temperature. Transformation temperatures of both alloys are over the room temperature, and both alloys are fully martensitic at room temperature. X-ray powder diffraction patterns and electron diffraction patterns exhibit super lattice reflection. An x-ray powder diffractogram taken from Cu-Al-Mn, at room temperature. Transformation temperatures of both alloys are over the room temperature, and both alloys are fully martensitic at room temperature. X-ray powder diffraction and electron diffraction studies were carried out on two copper based ternary alloys, CuZnAl and CuAlMn, at room temperature. Transformation temperatures of both alloys are over the room temperature, and both alloys are fully martensitic at room temperature. X-ray powder diffraction and electron diffraction patterns exhibit super lattice reflection.

The basal plane becomes ideal hexagon in the disordered phase region. These studies reveal that both alloys have unusual layered structure in martensitic condition.

X-ray powder diffraction profiles have been taken several times after post-quench heat treatments. These profiles reveal that peak locations and intensities of some diffracted planes change with ageing, and one can say that these changes lead to the rearrangement of atoms in crystal lattice of the materials. The {110} -type planes of parent phase turn into hexagon with martensitic transition, and atom sizes have important effect.

The basal plane becomes ideal hexagon in the disordered case taking the atom sizes approximately equal, and deviations occur from the hexagonal arrangement in the ordered case. Different between the interplane distances of some plane pairs providing a special relation between miller indices changes with ageing, and this change leads to disordering in martensite. The knowledge of deviation allows us to obtain information on the ordering degree of material crystal in the martensitic state.

Figure 1. An x-ray powder diffractogram taken from Cu-Al-Mn alloy sample.

Keywords: Shape memory effect, martensite, layered structures, atom sizes.