NANOSCALE CHARACTERIZATION OF MARTENSITE STRUCTURES IN COPPER BASED SHAPE MEMORY ALLOYS

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Abstract
Shape memory alloys take place in a class of functional materials exhibiting a peculiar property, shape memory effect. This property is characterized by the recoverability of desired shape on the material at different conditions. Shape memory phenomena are based on a solid state phase transformation, martensitic transition, which occurs on cooling from high temperatures. If these alloys are deformed in martensitic condition, they keep the deformed shape, when the stress is removed, and the material spontaneously returns to the original phase on heating over the austenite finish temperature. Shape memory elements cycle between the original and deformed shapes through heating and cooling in a temperature interval, and these alloys can be used as a thermal sensor or actuator in devices due to this property.

Copper based alloys exhibit this property in metastable b-phase field, and high temperature bcc-structures martensitically undergo non-conventional layered structures following two ordered reactions on cooling. The product phases have the unusual complex structures called long period layered structures such as 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice.

Martensitic transformations occur as variants by two or more lattice invariant shears on {110}-type planes of austenite matrix which is basal plane or stacking plane for martensite, as a first step, and the transformed region consists of parallel bands containing alternately two different variants. All of these martensite phases have long-period stacking ordered structures that are the underlying lattice is formed by stacks of close-packed planes. Metastable phases of copper-based shape memory alloys are very sensitive to the ageing effects, and heat treatments can change the relative stability and the configurational order of crystal planes.

In the present contribution, x-ray diffraction, transmission electron microscopy (TEM) and differential scanning calorimetry (DSC) studies were carried out on two Cu-Zn-Al and Cu-Al-Mn alloys.

Keywords: Shape memory effect, martensitic transition, layered structures, stacking sequence

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