TRANSFORMATION BEHAVIOUR AND SHAPE MEMORY CHARACTERISTICS IN Ti-Ni-Cu ALLOYS

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Ternary alloying elements addition to near equiatomic Ti-Ni shape memory alloys has been known to affect their transformation behaviour and shape memory characteristics. Among the alloying elements, Cu is a unique one. By substituting Cu for Ni by 10at%, the alloy transforms in two stages, i.e., from cubic(B2) to orthorhombic(B19), and then from orthorhombic to monoclinic(B19'), whereas the equiatomic Ti-Ni alloy in one stage, i.e., from cubic(B2) to monoclinic(B19'). However, details of the B2-B19 transformation characteristics in Ti-Ni-Cu alloys are not clarified fully.

Transformation behaviour of Ti-Ni-Cu shape memory alloys has been investigated by means of electrical resistivity measurement, differential scanning calorimetry, X-ray diffraction, transmission electron microscopy and shape memory characteristics of them by means of thermal cycling tests under constant load. Transformation start temperature for the B19 martensite, M_S', increased slightly, whereas that for the B19' martensite decreased largely with increasing Cu-content. Thus, the temperature range over which the B19 martensite was stable became wide. The B19 martensite did not involve internal defects such as dislocation and twin. This corresponded well to the fact that the lattice distortion associated with the B2-B19 transformation satisfied the invariant plane strain condition. The maximum recoverable elongation associated with the B2-B19 transformation decreased with from 3.2 to 2.7 %, and the hysteresis associated with the transformation decreased from 11 to 4 K with increasing Cu-content from 10 to 20 at%. These Cu-content dependence of the shape memory characteristics was found to be originated from the fact that the lattice deformation associated with the B2-B19 transformation decreased with increasing Cu-content. The temperature dependence of stress required to induce the B2-B19 transformation was nearly constant(about 8 MPa/K) without regard to the Cu-content for the alloys above 10 at%Cu.

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