ELASTIC CONSTANTS OF 2H MARTENSITE IN Cu-Al-Ni SINGLE CRYSTAL

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Elastic constants of cubic austenite and orthorhombic 2H martensite phases existing in the Cu-Al-Ni shape memory alloy were determined by an ultrasonic pulse-echo technique using single crystal specimens and a novel optimization based evaluation method. Martensitic single crystals for ultrasonic studies were prepared from three cube shaped austenite single crystals by a technique based upon cooling followed by a sequence of uniaxial compressions on different specimen faces. In this way, multiple martensite single crystals with different crystallographic orientations of the faces (martensite variants) were prepared.

Key words: *SMA, Cu-Al-Ni alloy, ultrasonic pulse-echo method, elastic constants, martensite*

1. Introduction

Cu-based shape memory alloys (SMA) are known to show thermoelastic martensitic transformations (MT) into various martensitic phases: β_1' – 18R, γ_1' – 2H, α_1' – 6R [1]. These MTs are first order phase transformations driven by the external stress or temperature. When the transformation proceeds, the phases are separated by mobile phase interfaces and have different elastic constants. Knowledge of the elastic constants of the individual phases is essential to describe reliably the mechanical behavior of SMAs.

Elastic properties of the cubic high temperature phases in SMAs [2, 3] are well known, including their temperature dependence, since the experimental reports frequently focus on changes of elastic constants in the vicinity of the phase transition. On the other hand, there are only few references in the literature concerning the elastic properties of the martensite phases in SMAs. This is mainly because of the difficulties related to the preparation of sufficiently large single crystals of low symmetry martensite phases.

Elastic constants of the orthorhombic γ_1' – 2H martensite phase in CuAlNi alloy were determined by Yasunaga et al. [4] using resonance ultrasound spectroscopy (RUS) technique. In the present work, we use pulse-echo overlapping method to evaluate the complete set of second order elastic constants of cubic bcc austenite and orthorhombic 2H martensite phases.

2. CuAlNi single crystal

A single crystal of Cu-14.3%Al-4.2%Ni (wt. %) alloy was grown by Bridgman method. Since transition temperatures were M_s(2H) $\sim$ 288 K and As $\sim$ 313 K (as determined by

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