Shape Memory Alloys (SMAs) are intelligent materials which are able to change their own shape in response to a variation in the outer temperature or to an applied tension over the material. These outstanding properties which are known as superelasticity, pseudoelasticity and shape memory effect are the consequence of the thermo-elastic Martensitic Transformation (MT). MT in Cu-Al-Ni takes place between a high temperature \( \beta \) phase which is cubic, and low temperature phases \( \beta' \) (monoclinic) or \( \gamma' \) (orthorhombic), depending on the alloy composition[1].

The Phenomenological Theory (PT) had been used to calculate the habit plane between austenite and martensite, as well as the possible twinning relationships between the different variants of martensite. These theoretical predictions were initially verified by optical microscopy, and the corresponding Orientation Relationships (OR) were determined by the back reflection Laue method. Most recently Transmission Electron Microscopy (TEM) and Electron Back-Scattered Diffraction (EBSD) have been used to confirm the PT on SMAs. But in spite of the fact that the EBSD is a powerful and fast method for orientation determination, barely any study has been focused on the systematic use of EBSD for martensite characterization on Cu-based SMAs.

Taking everything into account, in this work it is proposed EBSD as an efficient tool for the orientation determination of the martensite lathes and also for the characterization of the interface planes between martensites in Cu-Al-Ni SMAs. In order to achieve this goal, first a systematic and fast method for indexing martensites on Cu-Al-Ni SMA single crystal is proposed, where predictions of the interfaces of the variants are also given based on the self-accommodating groups. Second, directions and distances in degrees have been determined to reach the edge-on condition in the TEM for each OR between martensites for a proper characterization of the interface. This method has been tested on TEM samples from the bulk specimen where the characterization had been performed, obtaining a suitable match between the predictions and the TEM results.


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Fig. 1: Orientation determination of the martensites by EBSD, the notation used is the one described by Saburi[2]. The PT predicts that the interface for this case is $(402)_3\parallel(-40-2)_4\parallel(100)_{\beta_3}$. For the $\beta'_3-\gamma'_3$ case, the basal planes of both phases are parallel and come from the $(-202)_{\beta_3}$ as was observed previously by in situ TEM[3].

**OR:** $(402)_3\parallel(\bar{4}0\bar{2})_4\parallel(001)_{\beta_3}$

Fig. 2: Edge on TEM SAD pattern of the same interface described in the Fig1. Thus it has been proved that the interface predicted by the EBSD in conjunction with the PT is the correct one.

$$\beta'_3(3') B=[0\ 1\ 0]$$

$$\beta'_3(4) B=[0\ 1\ 0]$$

Fig. 3: Atomic 3D real space of the martensites in the same conditions than the diffraction pattern and EBSD maps. The PT arrows give the shift direction of atoms to become in lattice coincidence.