**MS-4-P-3457 Explanation of observed unusual X-ray Kossel reflection doubling at the ferromagnetic shape memory alloy Co-Ni-Al**


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Among the ferromagnetic shape memory systems the metallic compound Co-Ni-Al shows
particularly advantageous properties such as good oxidation resistance, low density and
appreciable ductility at room temperature, therefore current research activities are focussing
on a better understanding of the structure and the behaviour of this alloy.

In the present work austenitic single crystals with nominal composition Co$_{38}$Ni$_{33}$Al$_{29}$ were studied
by means of X-ray Kossel diffraction within a scanning electron microscope. The samples were
grown in [100] direction by the Bridgman method and wet-polished using conventional
metallographic techniques. Fig. 1 shows a SEM micrograph with two crystal phases present in
the sample, the matrix B2-β-phase with filigrane precipitates of A1-γ-phase. In the X-ray
diffraction studies, a further unusual doubling of X-ray Kossel reflections was observed close to
the phase boundary besides the Co-Kα and Ni-Kα (111) reflections in each case as can be seen
in Fig. 2. This doubling could be explained by an abnormal overlapping of Kossel reflections of
the two different crystal phases whilst allowing to determine precisely the orientation
relationship as Kurdjumow-Sachs:

$$(111)_{\text{A1}} || (110)_{\text{B2}}, [110]_{\text{A1}} || [111]_{\text{B2}}.$$

Moreover, remarkable dark regions (lower backscatter coefficient $\eta$ due to a channeling effect)
between the B2 matrix and the γ-phase were seen using backscattered electrons (see Fig. 1).
On the basis of Kossel investigations it may be concluded that this structure along the
boundary is connected to the measured exact plane orientation relationship between the
phase and the matrix: $(111)_{\text{A1}} || (110)_{\text{B2}}$ (misorientation within a few tenths of a degree) and
therefore reveals areas of excellent crystal quality with very low dislocation density.

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Fig. 1: SEM micrograph showing the different crystal phases using backscattered electrons.

Fig. 2: X-ray Kossel diffraction pattern of the ferromagnetic shape memory alloy Co-Ni-Al at the matrix close to the phase boundary. Overlaps of two Kossel reflection systems between the A1 and the B2 crystal phases can be seen.