MAGNETICALLY AFFECTED RECOVERY AND RECRYSTALLIZATION IN ALUMINUM ALLOY 3103

S. Bhaumik, X. Molodova, D.A. Molodov (RWTH Aachen University, Institute of Physical Metallurgy and Metal Physics)

Introduction

In a series of experiments performed at the NHMFL we have shown that grain structure evolution during grain growth in non-ferromagnetic metals (Zn, Ti, Zr) can be effectively controlled by means of annealing in a high magnetic field [1-4]. The results of quite recent experiments however revealed that a magnetic field can affect the microstructure evolution not only at the stage of grain growth, but also at earlier stages – recovery and primary recrystallization. Moreover, it has been found that the magnetic effect is not only confined to anisotropic metals but can also be observed in a material with isotropic properties.

Results

Cold rolled (71%) sheet specimens of Al-alloy 3103 were annealed at 290°C at zero field and in a field of 19 T for the time of 15, 20 and 40 min using a direct current resistive, 20 T Bitter magnet with a 195 mm bore diameter. Crystallographic texture was characterized by X-ray diffraction in the mid-layer of the sheet.

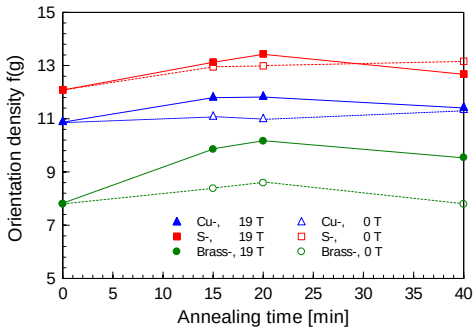

Figure 1. Orientation density of Cu-, S- and Brass-components in the crystallographic texture of cold rolled Al-alloy 3103 after annealing at 290°C without field and in a field of 19 T vs. annealing time.

After 15 and 20 min annealing in the field the typical components of cold rolled state (Cu-, S- and Brass-orientations) making up the so called ß-fibre become distinctly more intensive than after annealing at zero field (Fig. 1). Since an increase of orientation density of deformation components during annealing generally means a progress in the recovery of deformed material, the obtained results clearly indicate the enhancement of this process under the influence of a magnetic field. On the other hand, a decrease of intensity of deformation components, first S- and then both Cu- and Brass-orientations, usually refers to the beginning of primary recrystallization. Therefore based on an observed decrease of the density of S- and other components after 40 min annealing in the field compared to 20 min annealing (Fig. 1), it can be concluded that the primary recrystallization during the annealing in the field begins earlier than at zero field.

Conclusion

For the first time, it has been shown that microstructure formation during annealing of cold rolled commercial Al alloy can be affected by a magnetic field that exhibits in enhanced recovery and earlier beginning of subsequent primary recrystallization.

References

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