EBSD – and the recrystallisation of Ni-base alloys

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Recrystallisation of a material is a process that is often used to tune the mechanical properties of materials. Parameters like the volume fraction of the recrystallised grains, the size and distribution of the recrystallised and deformed grains and possible textures influence the behaviour of the material. Electron Backscatter diffraction (EBSD) has emerged as a very useful technique for the measurement of these parameters, not at least because of its ability to elucidate direct neighbourhood relationships between the grains.

EBSD was used to study the recrystallisation of a Ni-base-alloy (Böhler L306 VMR [Alloy 80A]). The specimens were compressed at a temperature of 1120° C and a constant strain rate of 0.1/s to different strains. Subsequently they were cooled down at air. Finally the cylindrical compression samples were cut to transversal cross sections at a quarter of the specimen height, were the local and the global strain rate correspond to each other. A more detailed description of the whole procedure can be found in Mitsche et al. [1]. The subsequent EBSD - measurements were performed by a TSL – system equipped with a SIT camera and attached to a Zeiss DSM 982 Gemini FEG – SEM.

Several methods have been proposed for the determination of the recrystallised fraction, but the grain orientation spread has proven most useful [1-3] and was used in this work. Figure 1 demonstrates clearly, that with progressive recrystallisation the recrystallised grains, which form a closed network, encircle every deformed grain. No big clusters of deformed grains could be found any longer. Starting from the grain boundaries, the deformed grains are gradually transformed into recrystallised grains, giving the deformed grains their “frayed” appearance. Therefore, corresponding to the increase of the fraction of recrystallised material, the mean diameter of the deformed grains is decreasing. As a consequence, nucleation for the recrystallisation process does seem to occur only at the grain boundaries of the deformed grains (necklace structure), but not within these grains themselves, which would cause a break-up of the grains. On the other hand, the mean diameter of the recrystallised grains is approximately independent of the size of the recrystallised fraction (Table 1).

Figure 2 (top left) shows, that no distinct texture is visible for the deformed grains for small strains (with only minor recrystallisation). But with the increase of the fraction of recrystallised grains, a pronounced texture does appear (Figure 2, top). It is caused most likely by the deformation of the material itself. Another possibility would be a preference for recrystallisation of grains with an orientation in the [111] direction. No texture was observed for the recrystallised fraction itself (Figure 2, bottom).

1. S. Mitsche, P. Poelt, C. Sommitsch, M. Walther, Proc. Micr. Conf. MC 2003, Microsc. Microanal. **9** (Suppl. 3) (2003), p. 344 – 345.
2. S. I. Wright, Proc. 12th Intern. Conf. on Textures (1999), p. 104 – 109.
3. J. Tarasiuk, Ph. Gerber, B. Bacriox, Acta Materialica **50** (2002), p. 1467 – 1477.
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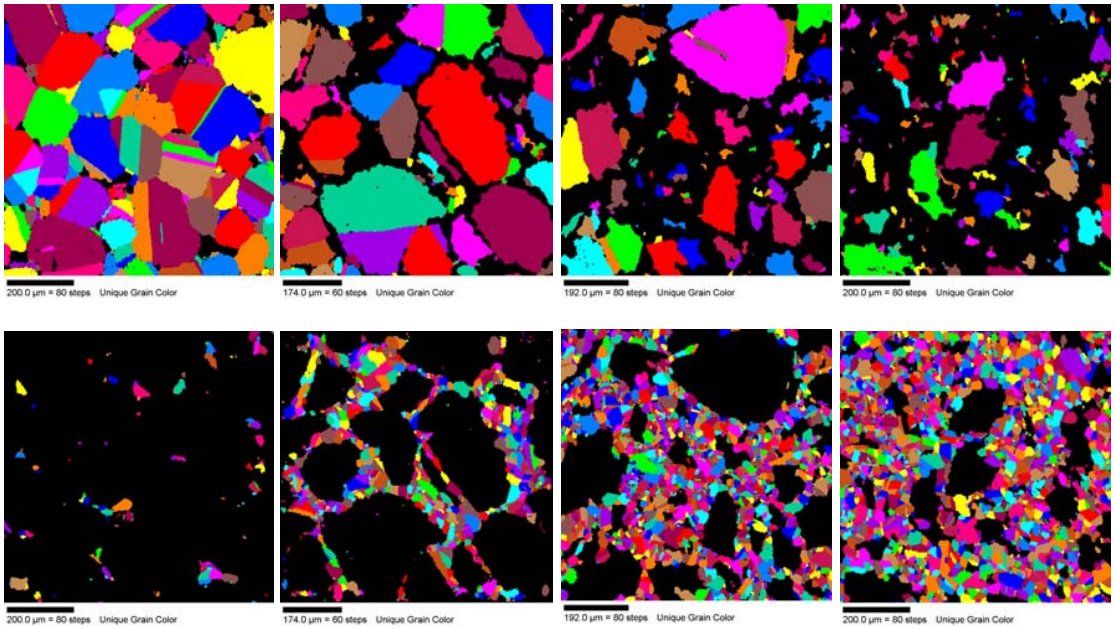

Figure 1. Grain map of the deformed (top) and recrystallised (below) fraction of a Ni-base-alloy, with the strain increasing from left to right (strain values as given in Table 1).

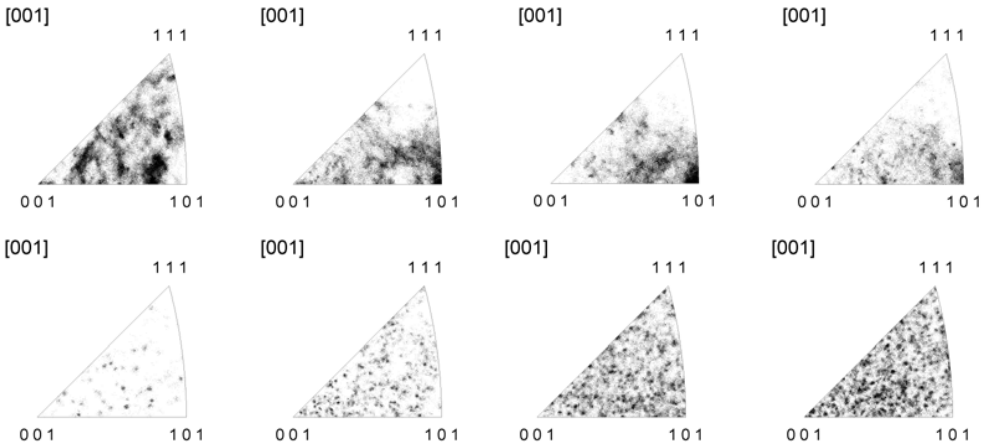

Figure 2. Inverse pole figure maps to the grain maps of Fig. 1 (top: deformed fraction, bottom: recrystallised fraction).

strain	grain size / µm deformed	grain size / µm recrystallised
0.105	46.2	17.6
0.303	33.7	17.5
0.500	33.6	16.8
0.700	30.8	17.8

Table 1. Grain sizes of the grains of the deformed and recrystallised fractions (mean diameter in µm).