# QUANTIFICATION OF THE RECRYSTALLIZED FRACTION IN A NICKEL-BASE-ALLOY FROM EBSD-DATA

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## INTRODUCTION

Recrystallization changes the mechanical properties of materials substantially. These changes are directly related to the volume fraction of the recrystallized grains. Electron backscatter diffraction (EBSD) is a useful technique to determine these characteristic parameters. Generally two methods are proposed to differentiate between the recrystallized and the deformed structure: the image quality (iq) and the misorientation [1,2]. The difficulties with these approaches and a comparison with optical microscopy will be demonstrated in this work.

## EXPERIMENTAL SECTION

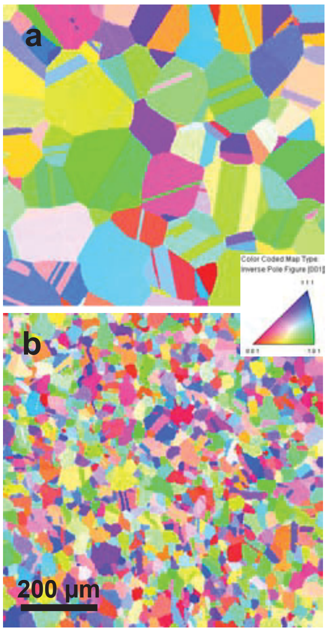



**Fig. 1:** Inverse Pole Figure map (IPF) ($E_0$= 20 keV and $I_p$= 2.8 nA) of:
**a:** Solution heat treated specimen
**b:** fully recrystallized specimen (sample B)

### Sample preparation:

- Cylindrical samples (h = 12 mm, d = 10 mm) were cut from hot rolled pieces.
- Solution heat treatment was done at 1220°C for 60 sec (resulting grains see fig. 1a).
- Hot compression tests were carried out on a Gleeble 3800 testing system (temperature = 1120°C, strain rate = 0.1/s).
- The specimens were polished first with diamond solution 0.25 µm and subsequently 0.5 h colloidal silica 0.04 µm.

### Results:

- Fig. 2a shows that with the image quality approach no discrimination between the recrystallized and the deformed fraction of sample A (IPF see fig 3a) is possible.
- Similarly the use of the grain average misorientation does not lead to a reliable bimodal distribution which enables to differentiate between the two fractions (see fig. 2b).
- Fig. 2c shows the grain orientation spread of the samples A and B (IPF of sample B see fig. 1b). For specimen A a bimodal distribution is discernible, which fits very well to the results gained by specimen B. The marked area in fig 2c indicates the region to determine the recrystallized fraction of sample A (resulting grains see fig. 3b).

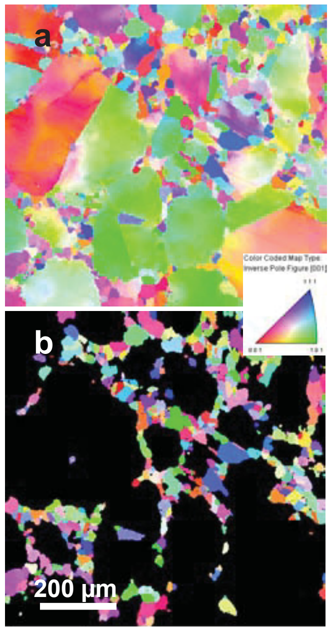
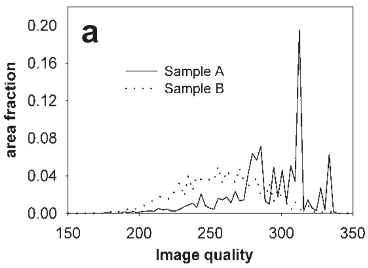
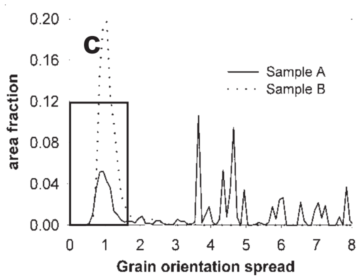



**Fig. 3:** InversePole Figure map (IPF) ($E_0$= 20 keV and $I_p$= 2.8 nA) of:
**a:** partly recrystallized specimen (sample A)
**b:** recrystallized fraction of sample A



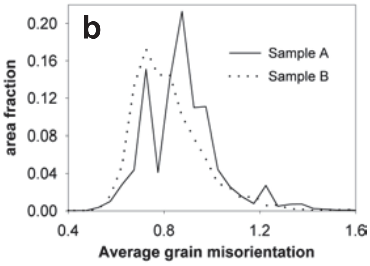




**Fig. 2:**
**a:** Image quality distributions
**b:** Average grain misorientation distributions
**c:** Grain orientation spread distributions with the marked range to determine the recrystallized fraction
Sample A: partly recrystallized specimen, see fig. 3a
Sample B: fully recrystallized specimen, see fig. 1b

### Comparison:

The reliability of the results obtained by the use of grain orientation spread is proven by Fig. 5, where the grain-size distribution, as obtained with EBSD-data, is compared with measurement by optical microscopy, where the recrystallized grains are distinguished from the deformed grains by setting a critical grain-size (see figure 4).

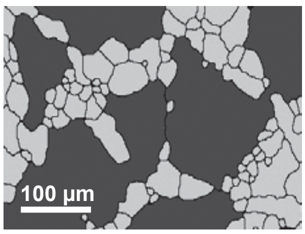



**Fig. 4:** Recrystallized fraction obtained by optical microscopy. Dark grey marks the deformed and bright grey the recrystallized fraction of sample A.

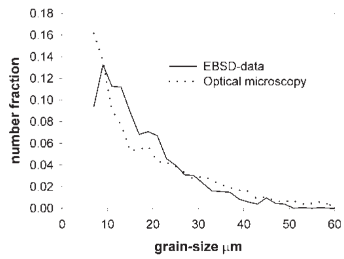



**Fig. 5:** Comparison of the grain-size distribution of the recrystallized fraction of sample A obtained by EBSD data and optical microscopy

## LITERATURE

[1]S. I. Wright, *Proceedings of the Twelfth International Conference on Textures* (1999) 104-107
[2] ] J. Tarasiuk, Ph. Gerber, B. Bacriox, *Acta Materialia* (2002) 1467-1477

## INSTRUMENTATION

- SEM Microscope LEO DSM 982 Gemini
- TSL-System (SIT-Camera, OIM 3.5)

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## CONTACTS

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