X-RAY LINE PROFILE ANALYSIS OF CALCITE DEFORMED BY HIGH-PRESSURE TORSION

Schuster, R.[1], Schafler. E.[2] & Abart, R.[1]

[1]Dept. of Lithospheric Research, Univ. of Vienna, Althanstrasse 14, 1090, Vienna, Austria
[2]Faculty of Physics, Univ. of Vienna, Boltzmanngasse 5, 1090, Vienna, Austria
e-mail:roman.schuster@univie.ac.at

X-ray line profile analysis (XLPA) is a powerful tool for investigating the microstructure and dislocation structure of highly deformed materials (UNGAR, 2004). This method allows to relate the characteristic broadening of Bragg peaks due to lattice defects and the finite size of the coherent scattering domains (CSD) to physical parameters such as dislocation density and the distribution of crystallite size.
In this study calcite samples subjected to torsional deformation under confining pressures in the GPa range to shear strains of up to 100 at temperatures between room temperature and 450°C were measured at the High Energy Materials Science Beamline at Petra III at DESY in Hamburg as well as the Microdiffraction Beamline at the ALS in Berkeley. The powder diffractograms were then evaluated by means of the convolutional multiple whole profile fitting procedure (CMWP-fit; RIBARIK et al., 2004). CMWP-fit permits fitting of a theoretical Bragg profile calculated from physical parameters to the measured diffractograms.
The results show that at high deformation temperatures the CSD size as well as the dislocation density saturate at low strains and strain rates, whereas grain refinement as determined by EBSD continues too much higher strains. The dynamic recovery at these elevated temperatures also shows a significant dependence on the confining pressure. At low temperatures no saturation can be seen, leading to significantly higher dislocation densities and reductions in CSD size. Through the analysis of the anisotropy of the lattice strain caused by dislocations the dominant slip system active during deformation could be established.

UNGAR, T. (2004): Scripta Mat., 51, 777-781.
RIBARIK, G., GUBICZA, J., UNGAR, T. (2004): Mater Sci. Eng. A, 387-389, 343-347.