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Microstructural studies of in situ heated and deformed polycrystalline halite

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The structure of a material consists of ordered atoms, ions, molecules, which determine the physical properties of a material. Depending on the orientation distribution of grains (=crystallites) in the polycrystalline material, the history of the material is only partly understandable by ex situ measurements. With help of in situ measurements, the processes taking place during texture development in dependence of the influencing factors: pressure, temperature, deformation, additives and grain sizes are studied.

Starting material was produced by cold pressing pure polycrystalline halite of different grain sizes and with different additives using a uniaxial press (100 tons). The powder was cold pressed at 200 MPa and finally heated 4-5 days at 150°C for recovery of the microstructure. The measurements were performed at the beamline BW5 in 1° steps in the omega angle range of +/-20°, while the cylindrical samples with 8 mm diameter were heated and deformed in axial compression with the tensile- compression device of Kammrath and Weiss. For heating a direct voltage and current supply on the sample is applied. The 2D images were recorded with a Perkin Elmer detector. For the grain orientation analysis, the programs FABLE [1], MAUD [2] and BEARTEX [3] were used.

The deformation experiments were performed in axial compression at different load steps until 2400 Newton in dependence of temperature and silica gel additives. The only deformed and simultaneously heated and deformed polycrystalline salt samples of different grain sizes show different trends in the ductility, the texture development and in the neighbourhood of single grain orientations, which are of great importance for the understanding of the processes taking place in the development of microstructure.

Goal of this work is to understand in detail, which are the important mechanisms in the development of the microstructure, influencing the material properties. Since 1978 compressed energy storage (CAES) in salt caverns is practised worldwide because of the high efficiency and the environmental acceptability. Especially salt would be a good representative for better understanding of the storage processes taking place in correlation to the microstructure.

References

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[2] Wenk et al. (1998). BEARTEX, a windows-based program system for quantitative texture analyses. J. App. Crystallogr. 31:262-269.
[3] Lutterotti et al. (1999) MAUD a friendly Java program for materials analysis using diffraction. Int. U. Crystallogra. Comm. Powder Diffraction Newsletter 21: 14-15.