Energy filtered TEM/STEM applied to mineralogical issues

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Introduction

The new generation of energy filtered TEMs opens an avenue of applications. They offer the possibility to investigate the crystal structure in the range of Å and the chemical composition in the range of nm. The studies were performed using two different TEM's. A conventional JEOL 3010 operating at 297 kV equipped with a LaB_6 cathode, post-column Gatan Imaging Filter and a 1 K slow-scan CCD camera and a LIBRA 200FE operating at 200 kV, equipped with a field emission gun, a 4 K slow-scan CCD Camera and a corrected 90° in-column Omega energy filter.

Investigated mineral systems

The first analysed system were collodial magnetic iron-based nanoparticles. These nanoparticles are used to enhance the contrast between normal and deseased tissues or to indicate organ functions or blood flow. Their structure is supposed to consist of an oxidized rim and iron core. Fingerprinting the electron loss near edge structure of the O K-edge enables to determine the oxide phase of oxidized rim [1].

The second inspected material was a partially metamict zircon from Sri Lanka, which was used for a hydrothermal experiment (gold capsuled experiment at 617 °C for 72 h and 1 kbar with 2 M $CaCl_2$) [2]. Under these conditions sharply bounded reaction fronts penetrate into the zircon, resulting in a reaction rim and an unreacted core. The nature of the structural and chemical changes induced by the hydrothermal treatment, as well as the mechanism of the alteration has been studied by EDX, energy filtered and high resolution TEM.

The third examined system are zirconolites. They are of prime importance in the conditioning of actinide radionuclides and they are proposed as a potential nuclear waste form for the incorporation of plutonium. A good test system is to incorporate Ce instead of Pu to analyse the influence of hydrothermal alteration. ELNES studies on the valence state of Ce will yield essential information on the reaction processes.

References

[1] Golla-Schindler U., Hinrichs R., Bomati-Miguel O., and Putnis A. (2006) *Micron* in press

[2] Geisler T, Pidgeon RT, Kurtz R, Brownswijk van W, and Schleicher H. (2003) *American Mineralogist* **88**, 1496-1513

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