Optical constants of presolar diamonds (revisited)

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Presolar nano-diamonds isolated from primitive meteorites are one of the possibilities to study cosmic material directly in the laboratory.

Various mechanisms have been proposed to account for the production of diamond grains in space, but the most likely scenario seem to be that the presolar nano-diamonds have condensed directly from stellar outflows (Lewis et al. 1987; Jørgensen 1988; Clayton 1989; Daulton et al. 1996).

In order to model these outflows it is important to know the absorption and scattering cross sections of the nano-diamonds. These data have so far only been available in limited spectral ranges. Lewis et al. (1989) made the attempt to combine measured infrared data with modified literature data of bulk diamonds in the ultraviolet. Ultraviolet data for persolar diamonds have been measured by Mutschke et al. (1996), Andersen et al. (1998), and Braatz et al. (2000), but only in a very restricted wavelength interval.

We have performed an extended spectroscopic study of nano-diamonds from the Allende meteorite to close the gaps in the data. Different spectrometers and different preparational techniques have been used to obtain absorption spectra from the Vacuum Ultraviolet (0.12 µ) to Near Infrared (3 µ) wavelengths. These data have been combined with already present infrared data to produce a consistent absorption spectrum which allows the derivation of the optical constants of the material by fitting with Lorentzian oscillators. Electron energy loss spectroscopy results are used to continue the data to even shorter wavelengths.

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AFM-examinations of dissolution and crystal growth processes on the (001) surface of schoepite

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The growing interest in environmental issues concerning radioactive waste and its disposal has lead to intensive studies on the geochemistry, paragenesis and structure of U-minerals. We have focused our investigations on uranyl-hydroxy hydrate minerals. This group of U-minerals forms early during the corrosion of U-bearing materials. One of the most common and preliminary uranyl-hydroxy hydrate minerals is schoepite, which transforms further into other uranyl-hydroxy hydrates such as compreignacite and becquerelite [1],[2].

During normal weathering cycles of wet and dry conditions the primary hydrated schoepite ($UO_3 \cdot 2H_2O$) alters into the more stable phase of dehydrated schoepite $UO_3 \cdot 0.8\ H_2O$ [3]. We therefore proceeded from synthesized dehydrated schoepite to examine its dissolution behaviour and the crystal growth processes of other uranyl-hydroxy hydrates on its (001) surface.

In order to examine the principal interactions of different saline solutions e.g. KCL, $BaCL_2$, $CaCl_2$ and $Pb(NO_3)_2$ with the (001) surface of dehydrated schoepite, batch and in-situ experiments at 25°C have been carried out. The concentrations of the solutions and the reaction times with the schoepite crystals were varied to achieve a representative overview of the different dissolution and crystal growth processes. The resulting changes of the morphology of the dehydrated schoepite (001) surface have been recorded with atomic force microscopy.

As the solutions interact with the surface of the schoepite crystals they dissolve and different kinds of etch-pits can be observed. It can be shown that orientation, shape and rate of formation of these etch-pits is closely coupled to the type and concentration of the cations in the solution.

As schoepite dissolves the solutions become oversaturated with respect to other secondary uranyl-hydroxy hydrate minerals. These minerals begin to precipitate on the (001) surface of schoepite. Due to the different solutions used, we observe epitaxial growth of e.g. compreignacite, becquerelite and wölsendorfite. The oriented growth of these minerals is controlled by the arrangement of undersaturated O-atoms on the (001) surface of dehydrated schoepite.

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