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Dynamics of water confined in chrysotile asbestos studied by inelastic neutron scattering

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We report the new data on the molecular dynamics of water confined in the "channels"of the crystal structure of chrysotile asbestos obtained by neutron spectroscopy. The neutron scattering measurements have been carried out on the time-of-flight spectrometer Sequoia at SNS (Oak Ridge, USA). The energy range up to 600 meV was covered with the instrument conditions selected to emphasize different parts of the full range of water vibration dynamics. The neutron spectra of the dry and wet samples were recorded at the identical conditions and the difference spectra were obtained by subtracting the 'dry'spectra from the 'wet'ones. Special care was taken to keep the preferred orientation of the fibers (c-axis) in the samples so that the resulting misorientation of the channels does not exceed ±12.5 degrees from a selected direction. The neutron scattering measurements were performed with the two sample geometries: with the channel axes along the neutron wave vector transfer Q in the scattering plane and perpendicular to the scattering plane. This permitted us to track the preferred direction of the hydrogen vibrations corresponding to different spectral ranges: acoustic, librational, molecular frequencies. We have found evidences for particularly strong anisotropy of confined water vibrations in the libration band (50-130 meV) which appears to be split onto 3 peaks. Such sharp peaks different bulk-ice phases were observed so far only in the inelastic neutron scattering spectra of the proton ordered phases (ice-II, ice-VIII and partially ordered ice-VI) while the proton disordered phases exhibit in this range practically featureless spectra, similar to that of ice-Ih. These observations have been confirmed in the measurements of deuterated water in the protonated asbestos what permitted us to move out from the range of strong vibration bands observed in the asbestos itself.

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