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Density profile of water confined in nanoslit

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Two surfaces in contact are found in everyday life. For hydrophilic surfaces in contact, the natural presence of a confined layer of water in the narrow gap between them has important implications for geochemical and biological processes such as swelling of clays and diffusion of water through nanopores. Numerous surface force experiments have been performed on such systems. However, force studies do not provide information on the molecular structure of the confined water. Recently we have adapted a surface force apparatus for specular X-ray reflectivity (XRR) determination of the electron density profile of the confined fluid across the gap. The confinement device features two freshly cleaved, cylindrically curved, mica membranes in crossed geometry, which are brought close together in order to create an atomically flat contact area. We determined by use of XRR the distance between the surfaces and the electron density profile of the naturally present water across the hydrophilic gap at nominal zero humidity. The mica surfaces were found to be apart by 1.35 nm. Water electron density profiles providing the best fit to the measured XRR-data show distinct peaks, indicating molecular layering of the water molecules. The results are in agreement with the predictions of recent Monte Carlo simulations. The average volume electron density of the confined water is 0.34 Å-3, a value similar to that of bulk water.

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