# Ultraconfined two-dimensional water in gypsum

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Abstract

Water plays an important role in a variety of processes, such as electrochemical reactions, energy storage, and biological processes, to name but a few. Most of the unusual properties and phenomena, such as abnormal dielectric constant [1] and unusual phase transitions [2, 3], are related to the extensive hydrogen bonding network in water, which is strongly altered under confinement.
In this study, we investigated the vibration of two-dimensional (2D) water sheets confined in a natural layered mineral, gypsum ($CaSO_4 \cdot 2H_2O$). Water O-H stretching modes are found to be localized on two types of O-H dipoles due to the two disparate hydrogen bonding strengths, resulting in two distinct vibration frequencies, which enabled us to study the dielectric behaviour of these two confined O-H dipoles independently. A distinct vibrational anisotropy is observed for the two local modes, indicating the orientation of O-H dipoles in such 2D confinement. By analysing the vibration frequency under different confining geometry of O-H dipoles, the dielectric polarization of nanoconfined water can be revealed. A concise model was constructed to describe the vibration and polarization of water under confinement.

References

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