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Modulating The Physico-Chemical Properties Of Water By Confinement In Hydrophobic NanoPores

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Water is the solvent of choice whenever hydrophilic substances are involved in a chemical process. However, because of its polar nature, the solubility of non-polar compounds in water is limited. The modulation of water's solvent properties to increase the solubility of non-polar molecules [1] would be ideal for phasing out the necessity of (organic) environmentally unfriendly solvents in the chemical industry.
The solvation power of water is governed by its hydrogen-bonding network. Furthermore, confinement of water in hydrophobic pores modifies its hydrogen bonding structure, making water a tunable solvent (the WATUSO principle [2]). Water intrusion in hydrophobic pores with diameters of 1-10 nm requires pressures from 0.5 to 20 MPa. Increasing the spinning speed of 4 mm NMR rotors in a Magic Angle Spinning (MAS) probe head, the centrifugal force in the sample increases, generating pressure and inducing intrusion of water in the hydrophobic pores. 1H MAS NMR and dielectric shift measurements, in situ in the NMR probe, reveal local level interactions between water molecules induced by the hydrophobic confinement [3].
In this work, we investigated the dielectric and spectroscopic properties of water, gradually forced into hydrophobic pores by increasing the MAS spinning rate. Silicates with different surface treatments have been used as confining media. Pore penetration results in a modified relative permittivity of the water phase, reflected in the dielectric shift observed in the NMR circuit and in the 1H MAS NMR spectra. These changes are related to the modification of hydrogen bonding network of water upon confinement in hydrophobic nanopores.

References
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