

Bowtie-Shaped Deformation Isotherm of Superhydrophobic Cylindrical Mesopores

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Deformation of superhydrophobic cylindrical mesopores is studied during a cycle of forced water filling and spontaneous drying by in situ small-angle neutron scattering. A high-pressure setup is put forward to characterize the deformation of ordered mesoporous silanized silica up to 80 MPa. Strain isotherms of individual pores are deduced from the shift of the Bragg spectrum associated with the deformation of the hexagonal pore lattice. Due to their superhydrophobic nature, pore walls are not covered with a prewetting film. This peculiarity gives the ability to use a simple mechanical model to describe both filled and empty pore states without the pitfall of disjoining pressure effects. By fitting our experimental data with this model, we measure both the Young's modulus and the Poisson ratio of the nanometric silica wall. The measurement of this latter parameter constitutes a specificity offered by super-hydrophobic nanopores with respect to hydrophilic ones.

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