Electronic Supplementary Information

Nanomechanical analysis of adsorption and desorption of water vapor on porous surfaces

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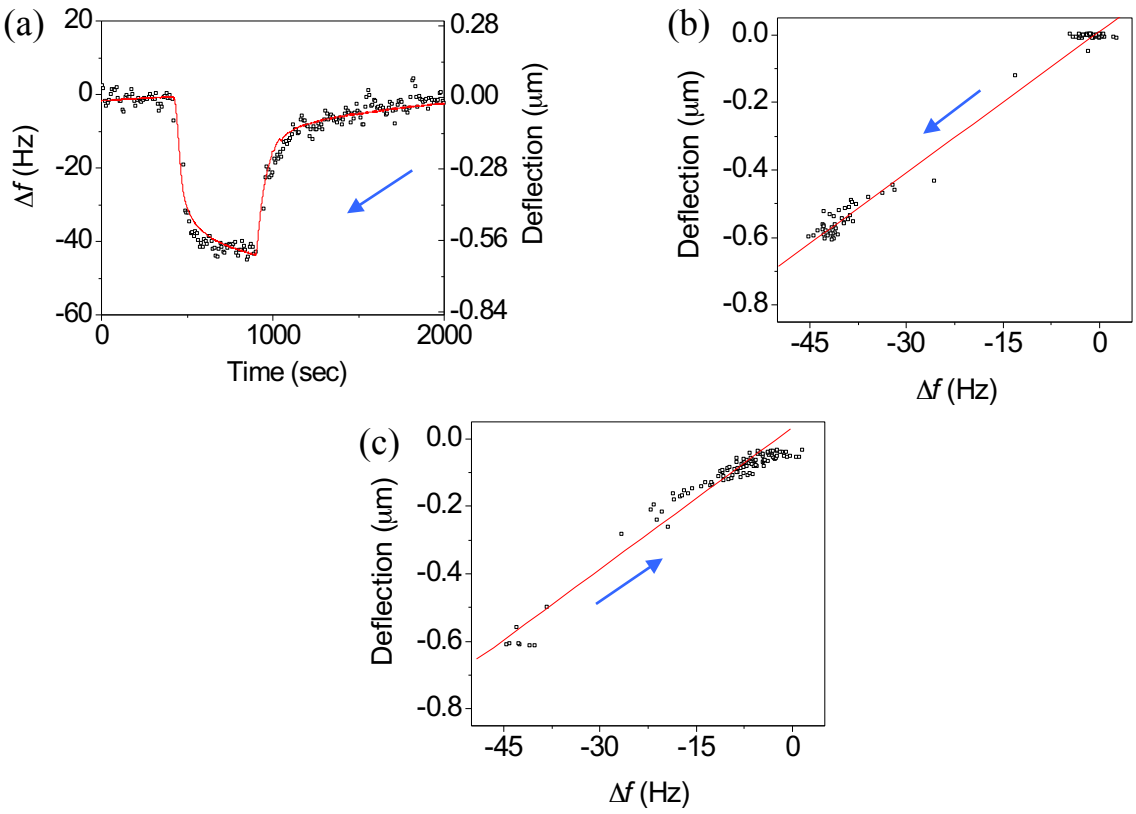

Figure S1. (a) Variations with time in the deflection (red curve) and resonance frequency (open square) of the AAO cantilever upon exposure to a relative humidity of 1 %. Variations in the deflection as a function of the resonance frequency during (b) the adsorption and (c) the desorption of water vapor. The arrows indicate the directions of adsorption and desorption. The changes in the deflection and resonance frequency of the cantilever superimpose on a single plot.

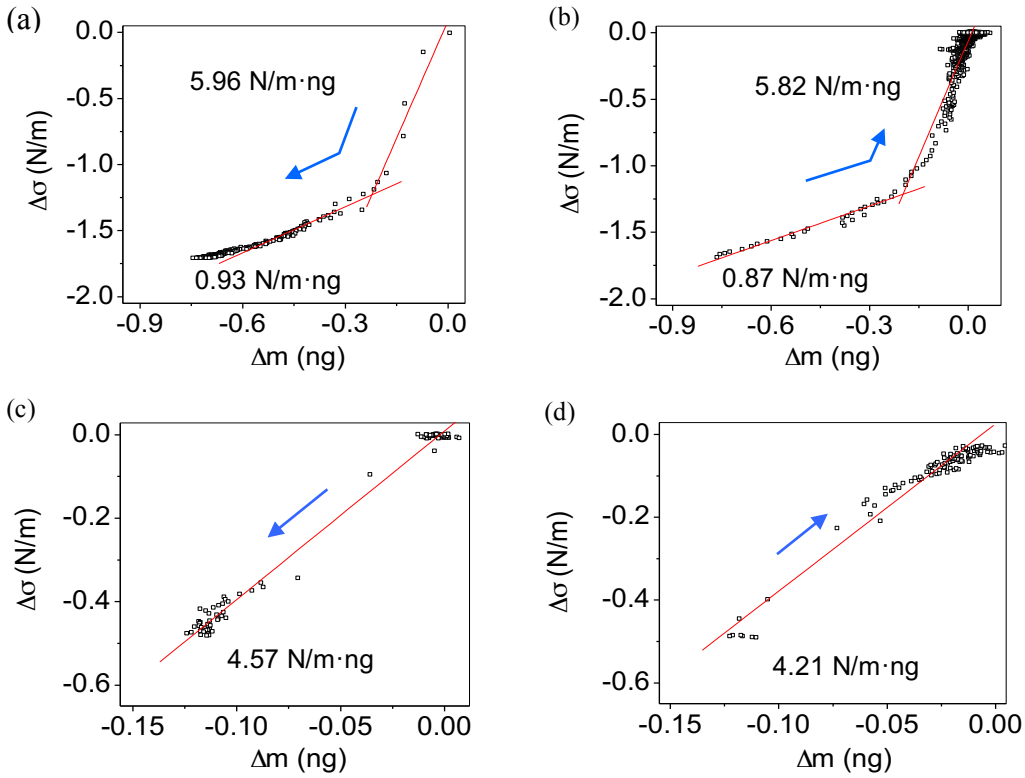

Figure S2. Variations in the surface stress as a function of the mass during (a) the adsorption and (b) the desorption of water vapor at relative humidity of 80%. Variations in the surface stress as a function of the mass during (c) the adsorption and (d) the desorption of water vapor at relative humidity of 1%. The arrows indicate the directions of adsorption and desorption.

Variations in the surface stress of the AAO cantilever and the adsorbed mass of water were calculated using Eq. (1) and Eq. (2) respectively. Figure S2(a) shows that the adsorption of water vapor under a relative humidity of 80% induced relatively large surface stress during the earlier stages but relatively small surface stress during the later stages for a given change in the adsorbed mass. The results obtained from the early and late stages of adsorption were best fit to linear models. The slopes of the adsorption were calculated to be 5.96 and 0.93 N/m·ng for the early and late stage of adsorption, respectively. Similar responses were observed during the desorption of water from the nanopores, as shown in Figure S2(b). The early stages of desorption induced relatively small deflections, even though more water molecules desorbed

during the early stage than during the late stage. Figure S2(c) and S2(d) shows variations in the surface stress as a function of the mass during the adsorption and the desorption of water vapor at relative humidity of 1%, respectively. In contrast with the two characteristic regimes observed at high relative humidities, a single regime was observed at 1% relative humidity, indicating that no transition from a sub-monolayer film to a multilayer film occurred. The slope of the line obtained at 1% relative humidity was 4.57 and 4.21 N/m·ng, respectively, nearly equal to the slope observed during the early stage of adsorption at 80% relative humidity, confirming that the adsorption produced a sub-monolayer water film on the AAO cantilever.