Mechanical response of hydrogel-functionalized solid supports using Newton's rings interferometry and surface forces apparatus

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Abstract

A recently-developed Surface Forces Apparatus (SFA) is used to investigate the mechanical response of a poly-N-isopropylacrylamide (PNIPAM) hydrogel. The compact design of the SFA allows for its easy incorporation onto a basic inverted microscope with a white light source filtered using a 25-nm band pass filter centered at 546 nm. First, we demonstrate that this simple optical setup allows to obtain Newton's rings patterns that give sub-nanometre precision on the distance measurement after spectroscopic characterization. Measurements in a glass-water-glass setup are consistent with DLVO theory at nanometric separations, and Hertzian contact models after contact. Next, we show that the instrument can also be used for the study of soft materials, with PNIPAM hydrogels as a first investigation. The experimental results show two asymptotic regimes: just after contact the force increases exponentially with penetration distance; then, we observe a transition to a power-law, force-distance relation at higher compressions of the gel.

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