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Nonlinear fluid dynamics of nanoscale hydration water layer[1]
WONHO JHE, BONGSU KIM, QHWAN KIM, SANGMIN AN, Seoul National University — In nature, the hydration water layer (HWL) ubiquitously exists in ambient conditions or aqueous solutions, where water molecules are tightly bound to ions or hydrophilic surfaces. It plays an important role in various mechanisms such as biological processes, abiotic materials, colloidal interaction, and friction. The HWL, for example, can be easily formed between biomaterials since most biomaterials are covered by hydrophilic molecules such as lipid bilayers, and this HWL is expected to be significant to biological and physiological functions. Here (1) we present the general stress tensor of the hydration water layer. The hydration stress tensor provided the platform form for holistic understanding of the dynamic behaviors of the confined HWL including tapping and shear dynamics which are until now individually studied. And, (2) through fast shear velocity (˜1mm/s) experiments, the elastic turbulence caused by elastic property of the HWL is indirectly observed. Our results may contribute to a deeper study of systems where the HWL plays an important role such as biomolecules, colloidal particles, and the MEMS.

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