Heterogeneous dynamics and superdiffusion in a 2D model system.

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ABSTRACT

We studied the bidimensional confined model system provided by a Langmuir monolayer of gold nanoparticles (GNP) of 5nm diameter at the air water interface subject to dynamical arrest. By X-ray Photon Correlation Spectroscopy (XPCS) we demonstrate heterogeneous dynamics and 2D superdiffusive behaviour on the nanoscale, similar to what we observed for a Langmuir monolayer of photosensitive azopolymers [1]. In particular we focus here on the fourth order susceptibility chi⁴, which is, at the best of our knowledge, for the first time directly accessed experimentally by our XPCS experiment, and allows a direct comparison with theoretical predictions. We discuss our findings also in light of the semi-macroscopic properties probed by 2D interfacial shear rheology [2] measurements performed on the very same system.

REFERENCES:


Left: Ellipsometric image of a Langmuir monolayer of GNP. Middle: XPCS relaxation time τ measured at several surface concentrations along different directions in the reciprocal space: q_/ and q_⊥ are respectively the directions parallel and perpendicular to the water surface. The anisotropic character of the dynamics is evident. Top Right: XPCS relaxation time τ as a function of the exchanged momentum q_/, measured at several surface concentrations. The inset reports the exponent n as a function of the surface concentration. The dashed line represents the mean value of n. Bottom Right: normalized variance χ (black dots) and the four times correlation function χ⁴ (red line) measured at ζ=30mN/m and T=18°C for at several values of q.