ESRF	**Experiment title:** Anisotropic Dynamics of Colloidal Rods in Dense Suspensions	**Experiment number**: **SC-5054**
Beamline: ID02	**Date of experiment**: from: 4/11/2020 to: 7/11/2018	**Date of report**:
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Report:

In this experiment, we studied the structure and dynamics (at nearest neighbour length scale) of β-FeOOH colloidal rods in bulk employing SAXS and XPCS techniques. Rods of two different aspect ratios $\rho = 20$ and $\rho = 8$ were measured over a wide concentration range ($\varphi \sim 0.03\ to\ \varphi \sim 0.23$). Although $\rho = 8$ worked out quite well, unfortunately, $\rho = 20$ did not work out as per expectation.

This was a challenging experiment, not only because of the ultra-small angle scattering set up and the opacity of the samples but also the experiments were performed remotely due to Covid-19 restrictions. Despite these difficulties excellent support from the beamline scientists helped us to measure at least one aspect ratio ($\rho = 8$) satisfactorily. Since the length scales of the particles with aspect ratio $\rho = 20$ were 250 nm × 12 nm, the XPCS set up in ID02 beamline was not suitable for them. We observed that at low ϕ, the system was too fast to be measured by the EIGER500K detector while at high ϕ, the system gets into a kinetically arrested state. Since this being a remote experiment, it was not possible to tune the concentration on the fly.

Results obtained from $\rho = 8$ system is described below. Fig.1 shows the structure and dynamics of $\rho = 8$ at $\varphi = 0.17$. The correlation functions have been fit with generalized KWW model (Fig. 1(a)) to extract the effective diffusion coefficient $D(q)$ (Fig.1.(c)). $D(q)$ shows a scaling behaviour with inverse structure factor (Fig.1(d)). This behaviour is known as de Gennes narrowing.

Fig. 2 represents the structure and dynamics of $\rho = 8$ for concentrations lying between $0.03 \leq \varphi \leq 0.17$ (different colour schemes correspond to different concentrations). We observe that as ϕ increases, the effective structure factor ($S(q)$) builds up (Fig. 2(a)). Further with increasing ϕ, the structure factor peak moves towards high q as expected, indicating the formation of more ordered structure. Fig. 2 (b) shows the variation of D(q) for all ϕ, which indicates that D(q) not only decreases with increase in ϕ, but exhibits de Gennes narrowing for all ϕ. The variation of D(q) with φ (Fig. 2(c)) indicates that the system approaches a kinetic arrest at high concentration.

Beyond $\varphi > 0.17$, a nematic followed by a smectic phase is formed (data not shown) for which a different data reduction scheme involving azimuthal sector average is needed , which is being currently pursued.

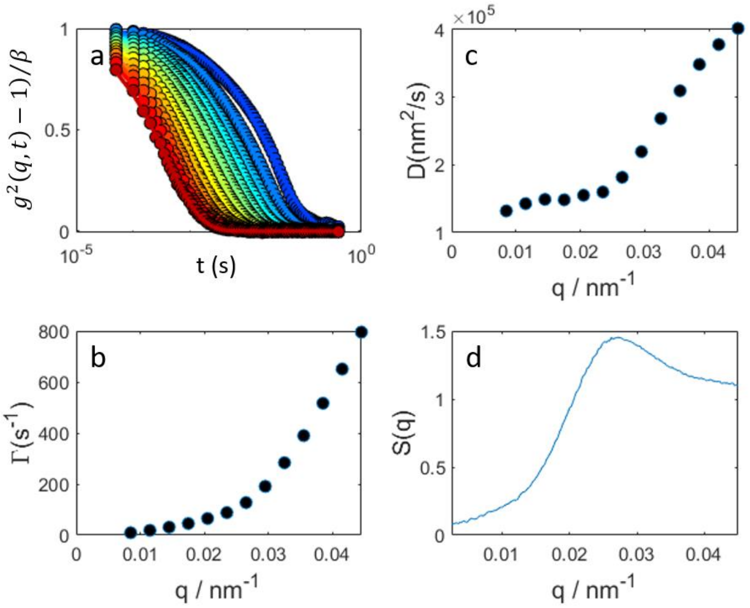

Figure 1: (a) Intensity auto correlation functions for different q values along with the fitting with generalized KWW model for ρ=8 at ϕ=0.17. (b) Inverse of correlation time, Γ, and (c) diffusion coefficient D(q) as a function of q. (d) structure factor S(q).

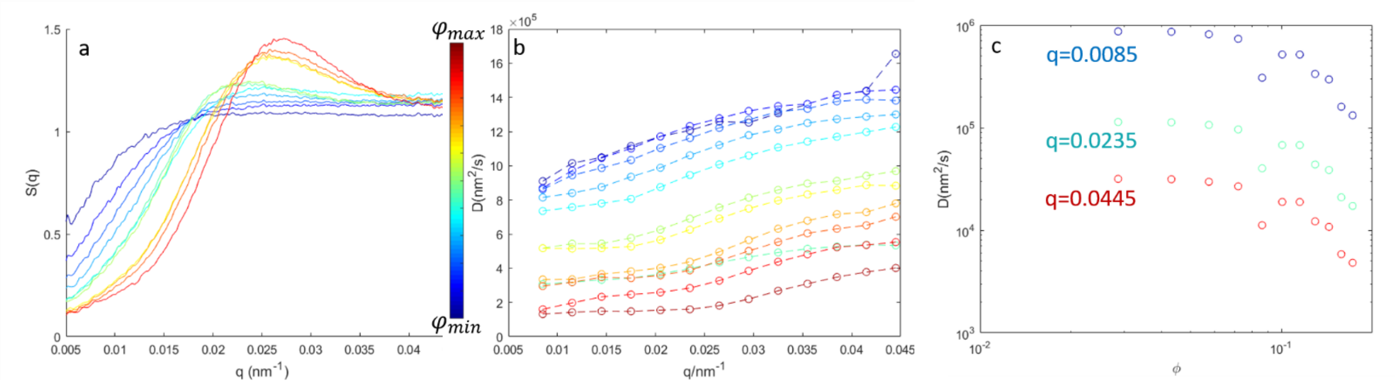

Figure 2: Variation of (a) structure factor S(q), (b) diffusion coefficients D(q) as a function of ϕ from ϕ=0.03 to ϕ=0.17. Different colour corresponds to different ϕ. (c)Variation of D(q) as a function of ϕ for three different q values.

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