Diffusion in isotropic and nematic phase [1]

At the isotropic-nematic phase transition the diffusion splits up in parallel ($D_{\parallel}$) and perpendicular ($D_{\perp}$) diffusion with respect to the nematic director. The ratio ($D_{\parallel}/D_{\perp}$) increases monotonically with increasing virus concentration.

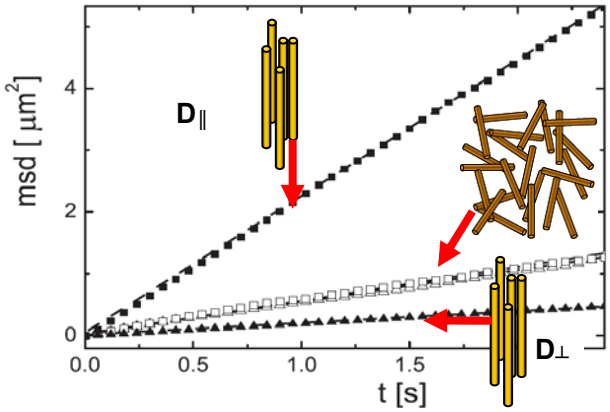

Fig.1 Mean square displacement in the isotropic phase (open symbols) and the nematic phase (solid symbols). Here it splits up in diffusion parallel (squares) and perpendicular (triangles) to the nematic director

The ratio absolute diffusion depends on the aspect ratio of the rods and the difference between the hydrodynamic diameter d_{hyd}, which is the diameter probed by the solvent molecules, and the effective diameter d_{eff}, as probed by the rods themselves. These diameters can be tuned by grafting the rods (d_{hyd}) or changing the ionic strength and thus the repulsion between the rods (d_{hyd}). The diffusion rate is relatively higher when $d_{eff} > d_{hyd}$, which is due to the reduced hydrodynamic friction, as can be seen in Fig. 2a. Also the diffusion rate increases after the isotropic-nematic phase transition, hinting that the positional entropy increased after the transition. Fig. 2b shows that the aspect ratio affects the ratio of the parallel over the perpendicular diffusion.

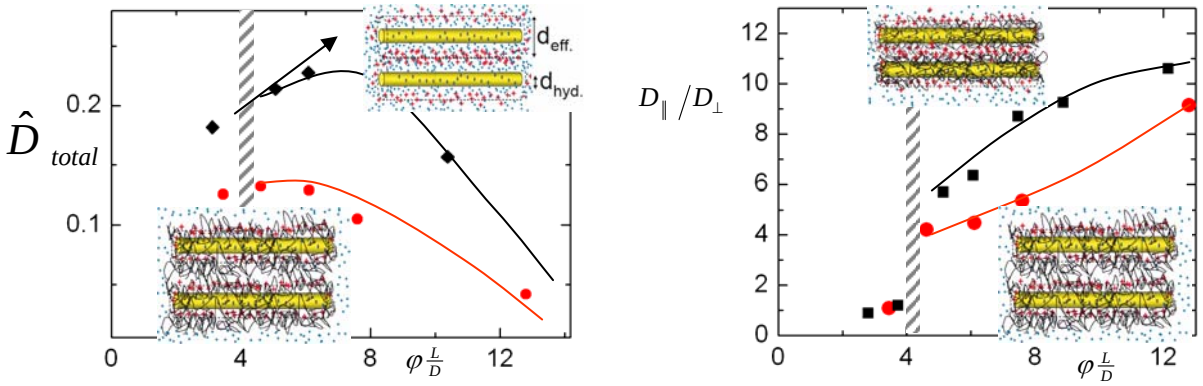

Fig. 2 (a) The total diffusion scaled by the diffusion at infinite dilution for bare rods at low ionic strength (black symbols) and rods coated with 20 kd PEO. (b) The ratio in the diffusion for rods coated with 5 kd PEO (black symbols) and 20 kd PEO (red symbols).

[1] M. P. Lettinga et al., Europhys. Lett., 2005, 71, 692.