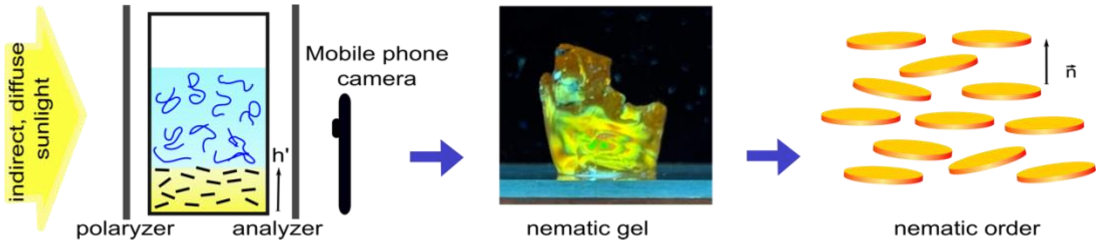
Aging in Nematic Gels



Motivation

Many computer and TV screens use liquid crystal (LC) display technology. LCs are pure solutions of anisotropic molecules. They are known as thermotropic LCs because their phase transition from an isotropic to nematic order is driven by temperature. Similar phase transitions are observed in solutions containing anisotropic particles that are smaller than a few micrometer. These systems are called lyotropic LCs, and their phase transition is driven by increasing the particles' concentrations. While it is easy to synthesize either rod- or disk-shaped molecules with thermotropic LC behaviour, it is almost impossible to synthesize disk-shaped particles. Therefore, may researchers have focused on natural clays, which are 2D-crystals of 1 nm thickness and a diameter of 30-500 nm. A clay example is kaolinite that makes porcelain. Because of their large thickness-to-diameter ratio they should be excellent liquid crystal formers. However, their complex charging state leads to strong aging and gelation rather than LC formation when suspended in water. Recently we were able to overcome the aging dynamics by compressing a dilute clay suspension through osmotic pressure, exerted by a polymer solution (Figure above) [1].

Your Project

We will study the transition of the osmotically compressed clay layer under a light microscope using a video-microscopy tool called **D**ifferential **D**ynamic **M**icroscopy (DDM) [2]. For this the student will build a suitable measuring cell and incorporate colloidal probe particles which we will follow in time. Their thermal fluctuations measured in terms of time-dependent scattering intensities will allow us to probe the transition of the clay suspension from an isotropic liquid to an anisotropic gel. Once established we can then test this transition & aging as function of various properties.

Requirements

Background in thermal & statistical physics would be advantageous. The applicant should be interested in experimental research and video microscopy.

Other aspects

The experimental study will be supervised by the Prof. Eiser, an experienced Soft Matter Physicist. Prof. D. Breiby's group will collaborate in terms of microscopy.

Contact persons

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[1] P. Xu, A.F. Yazici, T. Erdem, H.N.W. Lekkerkerker, E. Mutlugun, E. Eiser; *J. Phys. Chem. B* **124**, 9475-9481 (2020)
[2] M Zupkauskas, Y Lan, D Joshi, Z Ruff, E Eiser; *Chemical Science* **8**, 5559 (2017)