F. COMPLEX FLUIDS

Á. Buka, T. Börzsönyi, N. Éber, K. Fodor-Csorba, I. Jánossy, P. Salamon*, B. Szabó*, T. Tóth-Katona, A. Vajda

Synthesis – New non-symmetrical bent-core mesogens with a variable flexible chain length have been synthesized. The compounds were derived from 3-hydroxybenzoic acid, which is the central unit of the molecules. The tails on both ends were connected by ester functionality, one tail contains a terminal double bond and the other is saturated. The compounds represent novel non-symmetric molecules both in their core and tails. The main features of differential scanning calorimetry, polarizing optical microscopy, electro-optical and polarization current measurements for all studied materials indicate a transition between a single tilted synclinic ferroelectric and an antiferroelectric smectic phase.

Electric field driven pattern formation - Two electroconvection (EC) pattern morphologies - a cellular and a subsequent roll pattern - have been detected in the same frequency range in a nematic with positive permittivity and conductivity anisotropies. The frequency dependences of the onset voltages and critical wave numbers have been determined both for homeotropic and planar alignments. It has been proven that both pattern morphologies have a dielectric time symmetry. Possible sources for the pattern formation in the frame of both the isotropic Felici-Benard mechanism, as well as the standard model of EC have been considered.

A binary system made of bent-core and calamitic nematic liquid crystals has been studied by dielectric spectroscopy. The pure bent-core nematic exhibited two more dispersions than expected. Some dispersions occurred at unusually low frequencies, both in the nematic and the isotropic phases. It has been shown that the frequency dependent dielectric properties of the binary mixtures can be explained as a superposition of the dispersions of its constituents. The signs of the permittivity and conductivity anisotropies agree with those expected from the electroconvection morphologies.

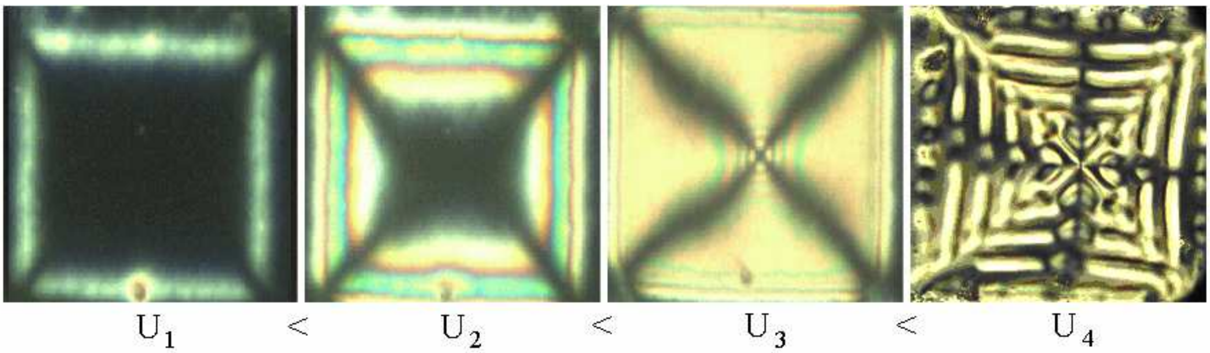

Fig.1 *Director distortion at increasing voltages.*

Director reorientation by electric and magnetic fields has been studied at electrode sizes comparable with cell thicknesses (see Fig. 1). It was found that reorientation starts at the electrode edges at lower voltages than in extended samples due to the field inhomogeneity. The

* Ph.D. student

symmetry of the deformation was broken by an additional magnetic field. Numerical simulation of the director field and the resulting birefringence has been carried out, resulting in a good agreement with the experiments.

Liquid crystal composite materials - Ferronematic liquid crystals of low negative anisotropy of the diamagnetic susceptibility have been prepared by doping the liquid crystal with magnetic Fe_3O_4 particles. High magnetic fields were applied perpendicular to, or parallel with the initial director. The observed structural instabilities have been interpreted within the Burylov and Raikher's theory. Using capacitance measurements, the Freedericksz threshold magnetic field of the ferronematic B_{FN}, and the critical magnetic field B_{max}, at which the initial parallel orientation between the director and the magnetic moment of magnetic particles breaks down, have been determined. The values of these quantities have been used to estimate the surface density of the anchoring energy W of liquid crystal molecules on the surface of the magnetic particles. The obtained values indicate a soft anchoring of the liquid crystal on the magnetic particles with a preferred parallel orientation of the magnetic moment of magnetic particles with the director.

Interactions at liquid crystal surfaces -

Granular dynamics - Shearing a granular material often leads to shear localization, where the region with the highest shear rate called shear zone usually finds the shortest way through the material. In an inhomogeneous (e.g., layered) system, where different regions (layers) are characterized with different effective friction, a more complicated trajectory will develop. When increasing the load on a layered system initially at rest, the zone will appear along that path which corresponds to the minimal resistance of the system (principle of "the easiest bond breaks"). This is similar to the well known Fermat's principle in optics, where the optimal trajectory of a light beam results from the minimization of the optical path. We have shown, that in the granular system the shear zone can be refracted at the layer boundary, analogously to light refraction.

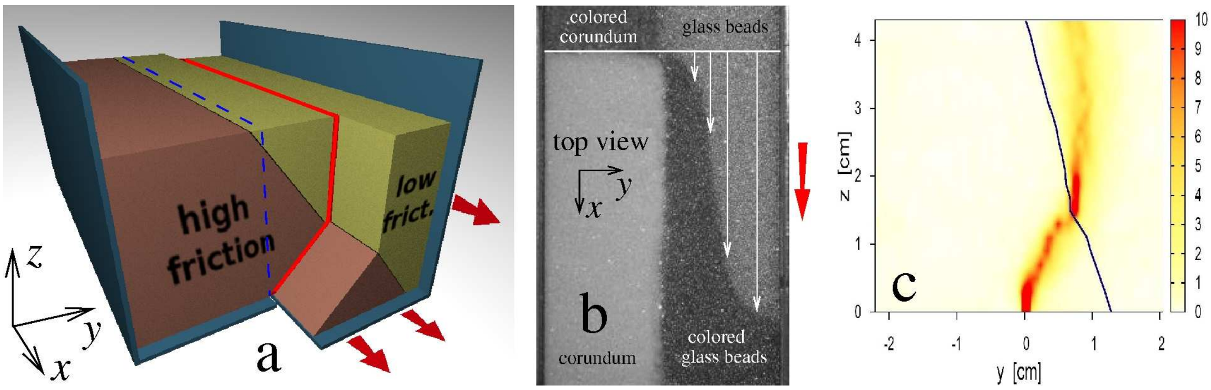

***Fig.2 (a)** Deformation of a granular material obtained by moving the L shaped boundary. In case of a homogeneous material the shear zone would be located in the middle of the cell as indicated by the dashed line. In a layered system however, the zone escapes the high friction part, changes direction at the layer boundary and comes to the top in the low friction part as it is indicated by the solid line. Deformation was visualized using colored samples as illustrated in panel **(b)**. The experimentally reconstructed deformation profile **(c)** fully agrees with the expectation **(a)**.*