2025.

Liquid crystals. – Director rotation and related domain wall motion induced by laser light absorption was observed in the ferroelectric nematic (N_F) phase of the archetypal liquid crystal DIO [1]. The observed phenomena strongly depend on the alignment of the ferroelectric polarization on the boundary plates with respect to each other and the direction of the laser light (as demonstrated in Fig. 1 for a laser line **L**). It is found that laser absorption in the electrodes of the cell plays an essential role in the observed phenomena. The main characteristics of the findings can be explained by a torque acting on the polar director due to a temperature gradient. These experiments provide the demonstration of a thermomechanical effect that is a property of polar fluids and does not exist in the conventional paraelectric nematic and antiferroelectric phases.

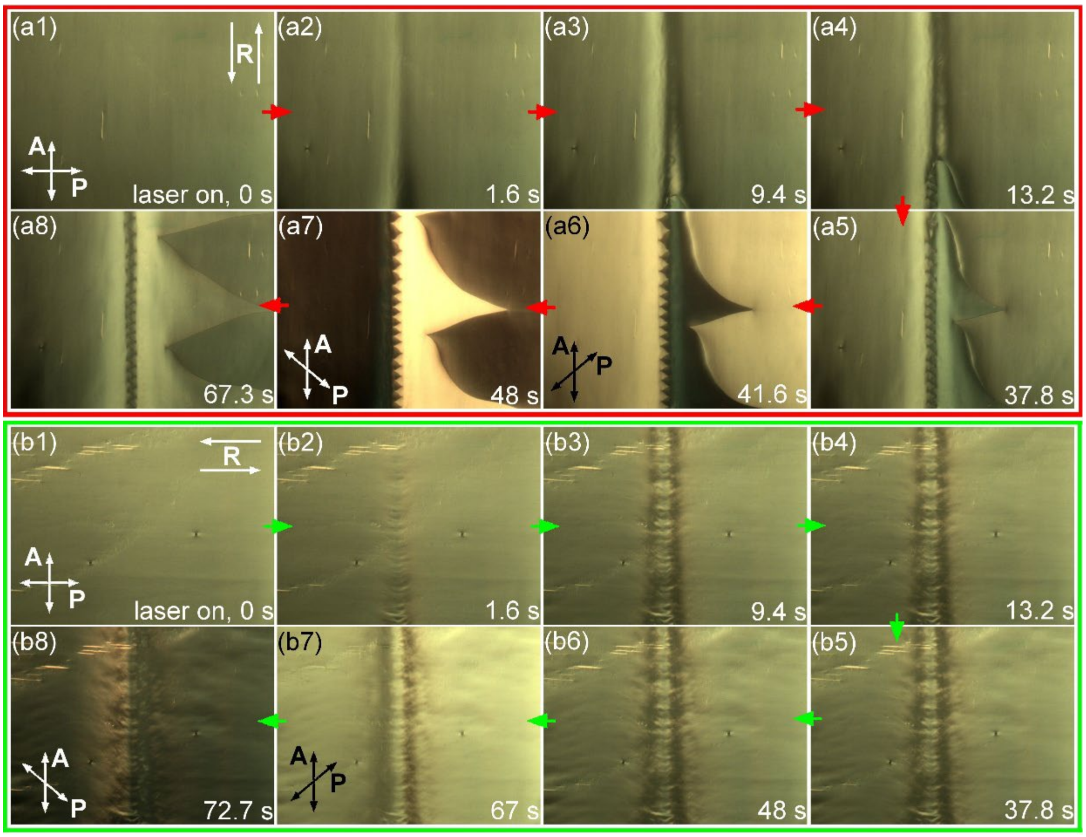

Figure 1. Temporal evolution of P=90 mW light-induced pattern in an antiparallel rubbed LC cell. **(a) R∥ L**, **(b) R⊥ L**. The times elapsed from the start of the illumination, the directions of the polarizer **P** and analyzer **A**, as well as the rubbing direction **R** on the substrates are indicated. The size of each picture is $1350\ \mu m \times\ 1050\ \mu m$.

We reviewed the history and evolution of piezoelectricity from the discovery of the Curie Brothers in a ferroelectric crystal, till today when an exceptionally strong linear electromechanical effect was observed in ferroelectric nematic fluids [2]. We pointed out the differences and similarities in the piezoelectric nature of solids and liquids and showed new results comparing the different piezoelectric coupling coefficients in distinct ferroelectric nematic materials. Furthermore, the challenges and possible future applications of liquid piezoelectricity were highlighted.

Granular materials. — For a usual granular material (frictional hard grains) the flow rate of an hourglass is constant in time, but for slippery soft grains (e.g. hydrogel beads) it decreases as the fill height is decreasing (as it is for a liquid). We characterize the flow behavior by the slope of the flow rate which is 1 for a liquid and 0 for frictional hard grains. We have shown that by adding only 20-30% of frictional hard grains to a sample of hydrogel beads we nearly recover the constant flow rate (flow rate slope strongly decreased – see Fig. 2a [3]).
In another study – focusing on the effect of grain shape on granular flow – we show that for elongated particles perturbing a simple shear flow (Fig. 2b) with a modulated force in the flow direction (as shown in Fig. 2c) results in a secondary flow perpendicular to the original flow direction (as it is illustrated in Fig. 2d) [4].

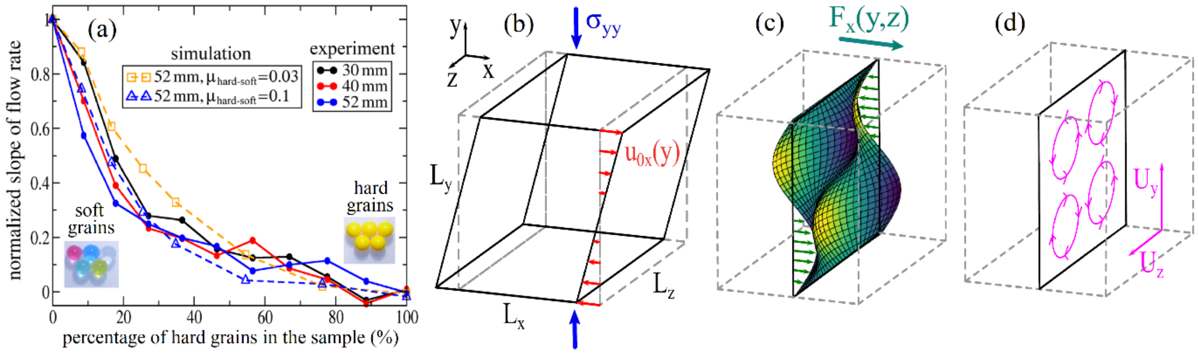

Figure 2. (a) Slope of the flow rate of an hourglass for a granular mixture [3]. (b-d) Secondary flow in a granular shear flow of elongated particles in the presence of additional perturbation.

Electrodeposited nanostructures. — We investigated the opportunity to cover Nd-Fe-B magnetic grains with a copper protecting layer [4]. The formation of a continuous coating could be achieved by using an aqueous bath, despite the strong tendency of Nd-Fe-B to oxidation. The dendrite formation of the electrodeposited copper could be suppressed by applying a suitable Cu deposition potential. Magnetization measurements confirmed the geometric parameters established from cross-sectional images of the thus obtained core–shell structure.

Strip-shaped thin foil samples exhibit MR(H) hysteresis curves of different shapes and widths in the longitudinal and transverse configurations. Magnetic measurements on similar strip-shaped samples also revealed differences that were attributed to demagnetizing effects. We showed that it is possible to explain the differences in the shape and width of magnetoresistance curves of a given material in a fully quantitative manner by taking into account the demagnetizing effects [5].

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