

The nature and art of liquid crystals

Discovered 130 years ago by Friedrich Reinitzer, liquid crystals are ubiquitous today—in displays small and large, in cosmetics and fashion, in cutting-edge sensors and actuators, and more. (See the article by Peter Palffy-Muhoray, *PHYSICS TODAY*, September 2007, page 54.) The rod-, disk-, or even banana-shaped molecules that make up liquid crystals have orientational order but at most only partial positional order. When matter is in a liquid-crystalline state, or mesophase, its refractive index, elastic modulus, viscosity, and other physical properties are strongly anisotropic, and the state is extremely sensitive to external factors such as temperature, electric and magnetic fields, and shear. Liquid crystals continue to attract attention from experimental, theoretical, and practical—not to mention aesthetic—points of view.

This natural-color photo shows a liquid crystal, 2.5 mm across and 5.1 μm thick, viewed through crossed polarizers. It's in a so-called smectic C* phase: Chiral molecules line up parallel to each other in

well-defined layers. Furthermore, the molecules are tilted with respect to the layer normal, and the angle twists in a helix from one layer to the next. The material exhibits both ferroelectric and antiferroelectric SmC* phases. This photo captures the sample just above the transition from an antiferromagnetic SmC* phase to a crystalline phase. Wojciech Tomczyk of Jagiellonian University in Kraków, Poland, took it as part of an investigation into mesophase ordering under the combined influence of the sample cell's top and bottom surfaces and of an AC electric field applied in the plane of the cell. The swirls are caused by the alignment of the helical axis in the plane of the cell, perpendicular to the field.

This image directly manifests liquid crystals' beauty and emergent physics. The fingerprint-like texture, with its dizzying array of blue and orange shades, brings to mind Vincent Van Gogh's famous *The Starry Night*—which, curiously, he painted one year after the discovery of the first liquid crystal. (Submitted by Wojciech Tomczyk.) —RJF

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