**Optical Nanotomography of Anisotropic Fluids**

Charles Rosenblatt et al., Case Western Reserve University

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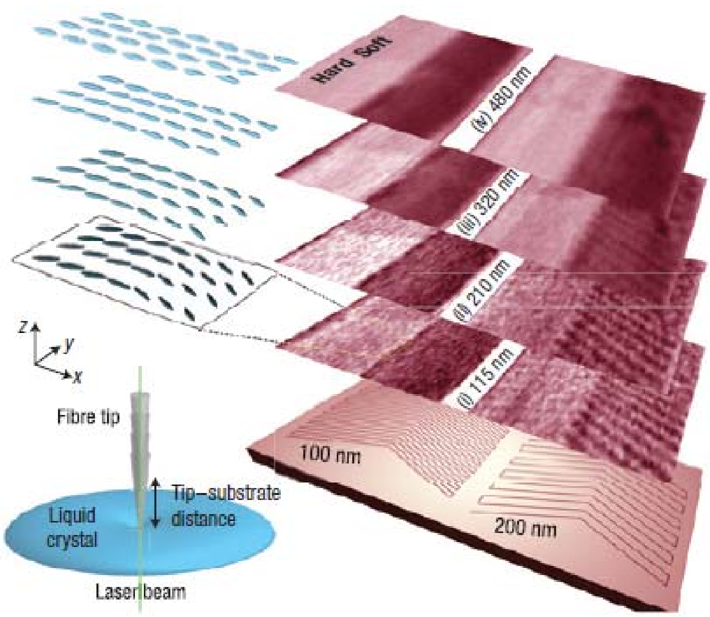
The physical properties of anisotropic fluids can be manipulated on very short length scales of 100 nm or less by appropriate treatment of the confining substrate(s). This facilitates the use of ordered fluids, such as liquid crystals, in a variety of applications ranging from displays to switchable optical elements such as gratings and lenses. Future advances will require a full understanding of the fluid's structure at the nanoscale level. But owing to diffraction limitations, high resolution three dimensional imaging of the molecular orientation profile has been beyond the reach of extant optical techniques. We have developed a powerful new imaging approach based on the use of polarized light emitted from a tapered optical fiber to investigate molecular orientation in three dimensions at nanoscale levels. We immerse the fibers tip inside a thin layer of the fluid, in our case a nematic liquid crystal, that sits atop a substrate and raster-scan the fiber at a series of heights above the surface. From the images collected in the far field we are able to obtain a three dimensional visualization of the liquid crystal's structure with a resolvable volume nearly three orders of magnitude smaller than attainable by extant methods.




**Optical Nanotomography Images at Different Heights**. A series of images created from the intensity data matrix collected at heights (i) 115 nm, (ii) 210 nm, (iii) 320 nm, and (iv) 480 nm above the polymer coated substrate, with an uncertainty of ± 10 nm. The scan dimension is approximately 15 x 9 μm. Polarizer makes an angle $\beta$ nominally equal to 7.5o and 37.5o with respect to the easy axes.

## References/Publications

A. De Luca, V. Barna, T. J. Atherton, G. Carbone, M. E. Sousa and C. Rosenblatt, *Nature Physics* **4**, 869-872 (2008).