

Surface-guided Crystallization of Theophylline for Regenerative Refractive Optical Elements

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Abstract: Numerous bio-organisms employ template-assisted crystallization of molecular solids to yield crystal morphologies with unique optical properties that are difficult to reproduce synthetically. We developed a facile procedure to deposit bio-inspired birefringent crystals of theophylline on a template of single-crystal quartz. Crystalline sheets with well-defined orientation were obtained, giving rise to high optical anisotropy in the plane parallel to the quartz surface, with a refractive index difference of $\Delta n \approx 0.25$ and a refractive index along the slow axis of $n \approx 1.7$. Patterning of the crystalline stripes with a tailored periodic grating leads to a thin, organic, polarization-sensitive diffractive meta-surface for polarization holography. Finally, we found a classical crystallization mechanism using time-resolved, in situ AFM. This enables local healing of the crystal surface upon mechanical or thermal deformation, thus allowing us to regenerate and regrow the crystal surface after patterning it with a grating. This opens the door to the reversible fabrication of various optical devices from a platform of small-molecule-based organic dielectric crystals.

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Short Biography: Dr. Angelica Elkan graduated summa cum laude with a B.Sc. in chemistry from Bar-Ilan University and pursued M.Sc. research at the Hebrew University under the guidance of Prof. Itamar Willner. She then embarked on Ph.D. studies at the Weizmann Institute of Science, supervised by Prof. Boris Rybtchinski, with a full scholarship from the Israeli Academy of Sciences and Humanities as an ADAMS fellow. Her doctoral research focused on the advancement of supramolecular plastic materials, characterized by their intermolecular, noncovalent interactions, for which she was awarded a prize from the Israel Chemistry Society. Since July 2021, Dr. Elkan has been conducting research at the Department of Physics of Complex Systems at the Weizmann Institute of Science and in the William A. Brookshire Department of Chemical and Biomolecular Engineering at the University of Houston, under the supervision of Prof. Dan Oron and Prof. Peter G. Vekilov, respectively, as part of the Women in Science combined postdoctoral program. Her current research is centered on developing bio-inspired optical components based on purine derivatives. Dr. Elkan will join the Materials Science and Engineering department at Tel Aviv University as a faculty member on October 1st, 2024.

