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Bottom-Up Shape Engineering of Molecular Single-Crystals.
GRIFFIN REED, MATTHEW LITTLETON, HALEY DORAN, DAVID PATRICK, Western Washington University — The ability to fabricate complex submicron-scale components from inorganic crystalline semiconductor materials such as c-Si enables countless modern technologies, from microelectromechanical systems to integrated circuits. For single-crystal molecular materials on the other hand, comparable approaches to defining micron- and submicron-scale structure are much less well developed, in part because weak intermolecular binding forces make molecular crystals vulnerable to damage by conventional techniques such as photolithography and energetic beam milling. Here we show how the same weak forces that are problematic for top-down patterning of molecular crystals can be exploited to enable controlled bottom-up growth, by leveraging shape plasticity. We describe a new approach to molecular single-crystal engineering based on bottom-up growth of single-crystals on sacrificial templates by vapor-liquid-solid (VLS) deposition. We demonstrate how these templates serve as molds for crystal formation, enabling growth of single-crystals with complex, even extraordinary shapes. The resulting new class of materials may help unlock functional features for molecular single-crystals via microstructural control over their photonic, thermal, charge transport, mechanical, and other fundamentally interesting and technologically valuable properties. Results are presented demonstrating a wide range of shape- and size-control modalities, including crystal topology, bounding perimeter shape, and nucleation position, for several families of small-molecule organic semiconductor and pharmaceutical compounds.

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