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Drying-Mediated Self-Assembly of Highly Ordered Complex Structures: From Polymers to Nanoparticles[1]

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Drying of a sessile drop containing nonvolatile solutes readily self-assembles into a number of concentric "coffee rings" by repetitive "stick-slip" motion of the three-phase contact line. However, due mainly to lack of control over the evaporation process of the drop, the challenge remains to use evaporative self-assembly to rationally "synthesize" "coffee rings" of different shapes and sizes of high regularity and fidelity. Here, we report a facile, robust, and one-step evaporation method for producing in a precisely controllable manner versatile microstructures possessing high regularity, dispensing with the need for lithographic techniques and externally applied fields. Polymer or nanocrystal solutions are confined in a simple geometry comprised of a curved surface placed upon a flat substrate. By changing the shape of the upper surface of the imposed geometry, the controlled, evaporative self-assembly of polymer or nanocrystal solutions yields a variety of complex, intriguing, and well-ordered structures over large areas. As such, this method represents a significant advance in creating regularly organized, complex structures with potential applications in microelectronics, optoelectronics, and biotechnology, among other areas.

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