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Patterning square and rectangular arrays using shear-aligned block copolymer thin films SO YOUN KIM, RALEIGH L. DAVIS, RICHARD A. REGISTER, Princeton University, JESSICA GWYTHER, ADAM NUNNS, IAN MANNERS, University of Bristol, PAUL M. CHAIKIN, New York University — Microphase separation of block copolymers in thin films can generate periodic structures: hexagonally packed arrays of dots from spherical or cylindrical phase block copolymers, or periodic stripes from cylindrical or lamellar phase block copolymers. Square or rectangular patterns, however, do not naturally form by spontaneous self-assembly of a simple diblock copolymer, and are a challenge to create. We present a simple way to create nano-square/rectangular arrays by building up a double-layer film of a cylinder-forming diblock, where each layer is sequentially deposited, shear-aligned independently, and cross-linked. Any block copolymer with at least one crosslinkable block can in principle be employed; in this study we use cylinder-forming polystyrene-b-poly(ferrocenylisopropylmethylsilane) and polystyrene-b-poly(hexylmethacrylate). The pitch of the array is tunable by varying polymer molecular weight. Oxygen reactive ion etching is used to reveal the grid structures, and these grids can in turn form nano-wells in the silicon substrate when the cylinder-forming block is very etch-resistant under the conditions used for silicon etching. Additionally, metal dots ordered in square arrays can be created using these grids as templates, via metal evaporation and lift-off.

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