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Combining block copolymer lithography with nano-imprinting lithography: Mass-producing sub-20nm unidirectional line patterns XIAODAN GU, SUNG WOO HONG, THOMAS P. RUSSELL, University of Massachusetts Amherst, UMASS AMHERST TEAM — A facile, simple pathway for mass production of highly aligned sub 20 nm unidirectional line patterns over arbitrarily large areas is reported. The directed self-assembly of block copolymers and nano-imprint lithography technique are combined together for this purpose. Polystyrene-b-poly(4-vinylpyridine) (PS-b-P4VP) was self-assembled on the faceted sapphire substrates to generate unidirectionally aligned cylindrical microdomains oriented parallel to the substrate. The nanoporous trench patterns were achieved by selective reconstruction of the cylindrical P4VP microdomains followed by oxygen plasma etching. The resulting 1D trench nanopatterns were characterized by scanning force microscopy, scanning electron microscopy, and grazing incident small angle x-ray scattering (GISAXS), yielding an orientation parameter of 0.974. A cyclic-siloxane was cast onto the polymeric trench nanopatterns and cured to make a negative replica. After demolding, the cross-linked siloxane replica was used as a second master to mass-produce unidirectionally aligned nanolines on various substrates with high fidelity, quality, and yield by nano-imprinting lithography technique. Importantly, this strategy works for both thermal and UV-assisted imprinting. The methodology may afford an easy approach for mass production of ideal templates for the fabrication of magnetic storage media, optical devices, and arrays of conducting wires.

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