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A Block Copolymer Self-Assembly Approach for 3D Nanoconfined Dopants in Semiconductors BHOOSHAN POPERE, BORIS RUSS, WILLIAM CHANG, University of California, Berkeley, ANDREW HEITSCH, The Dow Chemical Company, Midland, MI, PETER TREFONAS, Dow Electronic Materials, Marlboro, MA, RACHEL SEGALMAN, University of California, Santa Barbara — Continuous shrinking of electronic circuits presents a new challenge to demonstrate reliable, uniform nanoscale doping. Directed self-assembly (DSA) of block copolymers (BCP) has proved critical in meeting the technology nodes by enabling excellent pitch control for lithography. Yet, controlling the 3D dopant distribution remains a fundamental design challenge. To this end, we have utilized BCP self-assembly in a novel approach to confine dopants to nanoscopic domains within a semiconductor. The periodic nature of these domains affords precise control over the dosage and spatial positions of dopant atoms. Dopant incorporation within the block copolymer domains via hydrogen bonding eliminates the need for tailored synthesis, making the approach highly modular. Rapid thermal annealing of the self-assembled films effectively drives the dopants into the underlying substrate, thus confining them to within 10-20 nm in all dimensions. Additionally, the size, pitch, dopant dosage and the junction depth can be independently varied for a wide range of dopants. Compositional and electronic measurements indicate that the domains are indeed discrete and nanoconfined. Our approach, thereby, enables a facile method for controlled nanoscopic doping in semiconductors.

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