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From Nano- to Meso-Scale Order in Block Copolymer Self-Assembly-Derived Gyroidal Mesoporous Niobium Nitride PETER BEAUCAGE, SPENCER ROBBINS, JAMES SETHNA, FRANCIS J. DISALVO, R. BRUCE VAN DOVER, SOL M. GRUNER, ULRICH WIESNER, Cornell University — Niobium nitride is of academic and technological interest in fields including electrochemical energy storage and conversion and low-temperature superconductivity. Mesostructured nitrides can be obtained via sol-gel synthesis routes to oxides followed by conversion to nitrides via reactive heat treatment. In many applications of niobium nitride, the high specific surface area and pore accessibility available from block copolymer and oxide nanoparticle self-assembly could significantly improve material performance. Furthermore, mesoscale crystallographic order derived from block copolymer self-assembly could allow exploration of emergent properties in mesostructured superconductors. We report the first synthesis of gyroidal NbN superconductors from gyroidal block copolymer self-assembly-derived Nb_2O_5. The resulting materials have a mesoscale lattice with the $I4_132$ (alt. gyroid) structure and d spacings between 27 and 36 nm. The materials are superconducting with a Tc of about 8 K. We expect that block copolymer-inorganic hybrid co-assembly will be a scalable, tunable platform for exploration of the impacts of mesoscale order and porosity on superconducting properties, and will discuss recent efforts to vary the structure type and grain structure of the mesoscale lattice.

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