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Multiscale Self-Assembly of Quantum-Dots into an Anisotropic Three-Dimensional Random Network SERIM ILDAY, Bilkent University METU, FATIH ILDAY, Bilkent University, RENE HBNER, Helmholtz-Zentrum Dresden-Rossendorf, TY PROSA, ISABELLE MARTIN, CAMECA Instruments Inc, GIZEM NOGAY, METU, ISMAIL KABACELIK, Akdeniz University, ZOLTAN MICS, MISCHA BONN, DMITRY TURCHINOVICH, Max Planck Institute for Polymer Research, HANDE STNEL, METU, DANIELE TOFFOLI, Universita di Trieste, DAVID FRIEDRICH, BERND SCHMIDT, KARL-HEINZ HEINIG, Helmholtz-Zentrum Dresden-Rossendorf, RASIT TURAN, METU — Multiscale self-assembly is ubiquitous in nature but its deliberate use to synthesise multifunctional materials remains rare, partly due to the notoriously difficult problem of controlling topology from atomic to macroscopic scales to obtain properties by design. Here, we demonstrate an anisotropic random network of silicon quantum-dots that hierarchically self-assembles from the atomic to the microscopic scales: First, quantum-dots form, to subsequently interconnect without inflating their diameters to form a random network. This network then grows in a preferential direction to form undulated and branching nanowire-like structures. This specific topology allows simultaneous good electrical conduction and a tuneable bandgap. These scale-dependent features were previously thought to be mutually exclusive. Furthermore, we show that the topology is designed and self-assembled following an inherently modular, material-independent methodology, so that the approach is applicable to achieve programmable properties in other materials.

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