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The Electronic and Optical Properties of Nanoscale Meta-lattice Made by High Pressure CVD ZHAOHUI HUANG[1], VINCENT CRESPI[2], Pennsylvania State Univ — Meta-lattice can be defined as an artificial 3D superlattice with periodic structural modulation occurred at 10nm scale. One viable route to synthesize can be as follows: A template is first prepared by close-packed nanoscale silica spheres, then Si/Ge or a binary semiconductor is infiltrated into voids by high pressure chemical vapor deposition (CVD). Later silica spheres can be removed by chemical method, and voids in the inverse meta-latice offer a second opportunity for infiltration. Due to the characteristic length of voids, meta-lattice provides a platform to test novel mesoscopic electronic and optical phenomena. More specifically, a meta-lattice solid can be taken as a collection of molecular clusters connected by thin and narrow metabonds. Electronic properties are expected to share both characteristics of Bloch electrons and molecular states, for example, localized optical transition. Since a significan portion of atoms are located on the surface, the structural details may play a critical role. Here we employ large scale tight-binding calculations and non-equilibrium Green's function method to investigate the electronic (including electronic transport) and optical properties for Si meta-lattices.

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