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Boron suboxide properties and low pressure growth

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Boron Suboxide (B_6O) is a compound semiconductor possessing α-rhombohedral Boron type structure (R3m) and is the second most studied material of the Boron-Rich solids after B_4C. The allowed phase width of B_6O is expressed as $B_{12}(O_2\text{-}xB_x)$ where $0 \leq x \leq 1$. In the stoichiometric unit cell of B_6O, two oxygen atoms are positioned along the hexagonal <111> (c-axis) at the boron-icosahedral interstitial sites 2c, with the single 1b central position left unoccupied. The oxygen atoms donate one electron each to the boron icosahedra and compensate for the electron deficiency of pure α-B. The resulting short interatomic bond lengths and strong covalent bonding establish the bulk properties of B_6O, which possess the smallest unit cell volume of the α-boron derivatives. This structure is different from the semi-metallic structure of B_4C, where the 1b site is occupied and three interstitial atoms form a chain along the c-axis. When stoichiometric (x=0) B_6O is intrinsic high-resistivity semiconductor with an expected hole mobility at 300K approaching 100 cm2V-1s-1 and an optical band gap of about 2.5 eV and a melting point of 2075 ^{o}C. It is also a Super-Hard class material with bulk modulus of 314 GPa and a Vickers hardness exceeding 45 GPa. Sub-stoichiometric crystals of B_6O contain boron atoms replacing interstitial oxygen atoms and possess diminished properties. We will present a low pressure method for producing stoichiometrically correct B_6O macroscopic crystals, contrasting this method with alternate approaches in the literature and discuss applications for B_6O which include nuclear detectors and cutting technologies.

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