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Production of Amorphous Boron Powder via Chemical Vapor Deposition (CVD)

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Abstract : Boron exhibits the properties of high melting temperature (2273K to 2573 K), high hardness (Mohs: 9,5), low density (2,340 g/cm3), high chemical resistance, high strength, and semiconductivity (band gap:1,6-2,1 eV). These superior properties enable to use it in several high-tech areas from electronics to nuclear industry and especially in high temperature metallurgy. Amorphous boron and crystalline boron have different application areas. Amorphous boron powder (directly amorphous and/or α-rhombohedral) is preferred in rocket firing, airbag inflating and in fabrication of superconducting MgB2 wires. The conventional ways to produce elemental boron with a purity of 85 pct to 95 prc are metallothermic reduction, fused salt electrolysis and mechanochemical synthesis; but the only way to produce high-purity boron powders is Chemical Vapour Deposition (Hot Surface CVD). In this study; amorphous boron powders with a minimum purity of 99,9 prc were synthesized in quartz tubes using BCl3-H2 gas mixture by CVD. Process conditions based on temperature and gas flow rate were determined. Thermodynamical interpretation of BCl3-H2 system for different temperatures and molar rates were performed using Fact Sage software. The characterization of powders was examined by using Xray diffraction (XRD), Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM), Stereo Microscope (SM), Helium gas pycnometer analysis. The purities of final products were determined by titration after lime fusion.

Keywords : amorphous boron, CVD, powder production, powder characterization
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