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Horizontal Vapor Phase Epitaxy Growth of Silicon Nanomaterials for Terahertz Emission

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Abstract

This paper is about the fabrication and characterization of silicon nanomaterials for terahertz emission. Silicon (99.99% purity) bulk powder samples, weighing 0.035g each, were placed inside 0.15-m glass quartz tubes and sealed at 10-6 Torr. Horizontal Vapor Phase Growth Technique (HVPGT) was used to bake the vacuum-sealed tubes for 6, 7 and 8 hours with an 80 0C per minute ramp time. The growth temperatures for each growth time were 800, 1000, and 1200 0C. The tubes were cooled for 5 hours after baking. There were 5 baked samples for each growth temperature, one was used as a reference sample while the other four were cracked open and divided into Zone 1, Zone 2 and Zone 3. The samples were characterized using JEOL JSM-5310 Scanning Electron Microscope and Energy Dispersive X-ray (SEM-EDX) with gold coating, and Spectral microscope. The samples were tested for its capacity to emit THz pulse using the Terahertz-Time Domain Spectroscopy (THz-TDS) setup. The Zone 1 of the tube that has grown Si nanowires (SiNW), with energy band gap = 2.21 eV, baked in 1200 0C for 7 hours was the only sample that has satisfactorily emitted a THz signal with frequency bandwidth = 400 GHz, with an adequate signal-to-noise Ratio (SNR).

Keywords

Nanomaterials, terahertz, Silicon, Horizontal Vapor Phase Epitaxy Growth