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Elastic constants of as-deposited amorphous SiC thin films by Brillouin Spectroscopy

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Silicon carbide (SiC) has proven to be the future of Micro-electromechanical systems. Previous research has dwelled on the properties of SiC thin films on Si or silicon-on-insulator substrates and it has been a success in realising the potential of SiC (van Rijn, 2013). However, due to the difficult micromachining process and high density of defects when dealing with the SiC substrate , the elastic properties of a-SiC thin film on 3C-SiC and glass substrates remain a subject of tremendous scientific interest. In this study, a complete set of elastic constants of amorphous SiC thin films were determined by Surface Brillouin Scattering. The films were deposited by RF magnetron sputtering using a commercial SiC target. Subsequently the films were characterized using scanning electron microscopy, atomic force microscopy, and Raman spectroscopy to study the surface morphology and structural properties. Raman showed a strong randomization of Si-Si (500 cm⁻¹), Si-C (780-800 cm⁻¹) and C-C (1400 cm⁻¹) modes suggesting the films were amorphous. Velocity dispersion curves of surface acoustic waves in SiC films deposited on glass, were obtained, from which the dispersive Rayleigh mode was measured at 5120 m/s. Simulations of SBS spectra of SiC thin films on silicon and glass substrates were carried out to inversely extract the elastic constants of the films. The simulations were based on the elasto-dynamic Green's functions method that predicts the surface displacement amplitudes of acoustic phonons. Sound velocities for both transverse and longitudinal waves were determined along with the elastic constants C₁₁, C₁₂, C₁₃, C₃₃ and C₄₄.

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