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SBS observation of higher order resonances in annealed, carbon implanted CVD

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Abstract content
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The phase velocity of Surface Acoustic waves exhibits no dispersion in homogeneous materials. However, normal or anomalous dispersion takes place in layered systems. This dispersion effect has been used to determine the elastic constants of thin films. However, gradients in materials properties in the near surface region lead to dispersion effects also and therefore can be easily detected by surface acoustic waves (SAWs). We have used this technique to study changes in shear elastic constants of diamond irradiated with carbon ions in the energy range typically used in doping semiconductor materials. These particles only penetrate ˜ 0.3 micron into the material which produced a high defect concentration for the fluences used, which, in our case, led to amorphization of the implanted diamond volume. In this study we generated and detected SAWs on the as-implanted CVD and on the annealed radiation damaged CVD plates after deposition of a very thin Pt film of thickness of 20 nm to enhance surface reflectivity. With increasing dispersion (k||h), the Rayleigh wave velocity falls gradually from that of crystalline Pt to that of annealed amorphous CVD layer. At critical values of product of parallel wavevector and film thickness (k//h), Sezawa modes split off from the bulk wave threshold of the substrate (transonic state). These are guided modes with the displacement field having an oscillating component in the layer, and falling off exponentially in the substrate. In combination with the velocity of the longitudinal bulk waves, we were able to calculate the Poisson ratio and Young's modulus of the implanted regions.

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