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Classification of charge relaxation processes in diamond on silicon based devices

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Abstract

Diamond thin films on p-type Si prepared via a bias enhanced chemical vapor deposition technique and equipped with Al Schottky contacts are studied by charge deep-level transient spectroscopy. Three charge relaxation processes can be resolved in Q-DLTS spectra: (i) a spectrum of relaxation times centered about a thermal energy of 0.33 eV has been assigned to hole traps induced by Al/diamond interface dipoles. These are metastable when heating the diodes to 450 K during a Q-DLTS scan, (ii) quasi discrete energy levels at 0.82 and 0.98 eV are indicative of an amorphous (hydrogenated) Si (a-Si:H) interlayer between the Si substrate and diamond film. This conclusion results from a direct comparison with Q-DLTS spectra of a-Si:H based devices and (iii) a slow charge relaxation with a non-exponential kinetics responsible for a Q-DLTS signal tail independent of the rate window for longer times of observation. This phenomenon is known from frequency-domain observations as ‘nearly constant loss’.

Author Keywords: Diamond growth and characterization; Interface dipole; Si amorphization; Dielectric loss