

349e Conduction in Nanostructured Diamond

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Nanocrystalline diamond can exhibit quite different electronic properties to microcrystalline or single crystal forms of this remarkable material. For example, nitrogen incorporation into diamond displaying grain sizes in the range of 3-5nm (often known as ultra-nanocrystalline diamond or UNCD) leads to n-type conductivity, with little thermal activation being required. In single crystal diamond nitrogen forms a very deep donor state (1.7eV), an n-type conductivity is not seen at useful temperatures. In films with slightly larger grains (50-100nm, NCD), we have observed similar reductions in the need for thermal activation following the incorporation of boron, a p-type dopant which normally has an E_a value of 0.37eV.

This paper will review our current understanding of electronic transport processes within NCD and UNCD films, drawing on aspects of our recent collaborations with the diamond teams at Argonne National Labs and the Naval Research labs, both in the USA. Results from impedance spectroscopy, Hall effect measurements, DLTS and I-V/C-V data will be presented.