Metallisation and electrical characterisation of polycrystalline CVD diamond for particle tracking applications

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Synthetic diamond has unique utility for the high-radiation environment at the heart of the ATLAS detector of the Large Hadron Collider (LHC): the pixel detector that tracks initial particle trajectories. I report here on the metallisation and electrical characterisation of a polycrystalline chemical vapour deposition (pCVD) diamond sample, to function as a reference sample for subsequent experimental work by researchers at the University of Melbourne and Syracuse University exploring the viability of synthetic diamonds as a replacement for silicon in the ATLAS pixel detector.

Powerful technological and economic factors motivate this research. Diamond's unique radiation hardness (with its large band-gap of 5.5eV and displacement energy of 42eV/atom) will potentially yielding a pixel detector whose working life far exceeds that of the existing silicon technology [1]. Furthermore, a synthetic diamond detector can be run at room temperature, eliminating the need for expensive cooling systems. Performance degradation under prolonged radiation exposure is far slower than for silicon [2,3].

While there has been significant recent progress towards prototyping single- and polycrystalline CVD diamond pixel modules for particle tracking [4–6], the various groups pursuing this research lack a common set of reference parameters and values for the fundamental electrical characterisation of their samples and for benchmarking sample behaviour under radiation exposure. Accordingly, the present research is geared towards generating electrical reference data to enable cross-comparison between the various pCVD tests, and between poly- and single-crystal tests. A pCVD reference sample is metallised for initial electrical testing by ion-beam induced current (IBIC) imaging; re-metallisation for measurement of current vs. voltage spectra is planned, before beam tests.

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