Physics of Diamond

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The unique properties of diamond have identified it as one of the most attractive materials, which may satisfy the stringent requirements for a range of devices associated with modern very bright X-ray sources. This identification is based on Figures of Merit (FoM) for a quality of diamond near the theoretical limit of the perfect material. The demands relate to the crystal size and the control of defects and impurities in relation to lattice quality and electronic behaviour. The post-processing techniques, which lead to the required structures, should also not introduce any additional defects that compromise device performance. One finds that the physics issues that make diamond attractive in this context also make it difficult to realise the materials science goals of producing devices to the required specifications. Notwithstanding this, dramatic progress has been made, and it is clear that advances in understanding the physics of diamond have played an important role in developing the procedures of growth, modification and processing. It fact, the quality of synthetic material can now exceed the best natural material reproducibly. It appears a well-planned and co-ordinated effort would lead to the realisation of device quality diamond. This talk will discuss the defects and impurities most relevant to the issues of growth, defect engineering and material processing. This will be a general review to provide a context for the presentations that follow.