

# Choice of diamond type, Ib or IIa, for use in X-ray optics: Implications for HPHT synthesis

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The synthesis of type Ib diamond crystals for use in synchrotron X-ray applications has been discussed by Sellschop et al <sup>[1]</sup> and Sumiya et al <sup>[2]</sup> have discussed the synthesis of type IIa materials. Type Ib contains approximately 100 ppm of atomically dispersed nitrogen, known as C centres. Although this has a limited effect on the crystal quality, principally the X-ray rocking curve width, in practice this may not be a barrier to their use. Hoszowska et al <sup>[3]</sup>, Sellschop et al <sup>[4]</sup>

In this presentation we show that the nitrogen is not a neutral impurity at the stage of crystal growth from transition metal solvent/catalyst. It has the effect of increasing the growth rate achievable without uptake of metallic impurities, improving the internal structure of the diamond, as evidenced in the absence of minor growth sectors (110), (113) and similar, and also in some way inhibiting the formation of cracks in the crystals during the stage of depressurisation after growth. The negative consequences of a trace level of nitrogen atoms are typically the yellow colour caused by absorption in the blue region, slightly increased X-ray rocking width and marginally lower thermal conductivity. These could possibly be accommodated by appropriate design of the X-ray optics and cooling.

Where type IIa diamond crystals have been grown at HPHT, using chemical getters for example, the solvent/catalyst must be augmented with additional agents to enhance the crystal quality <sup>[5]</sup>. These agents, usually proprietary, have the effect of producing additional impurity centres in the diamond, which can result in measurable electrical conductivity or phosphorescence.

The HPHT process relies on the precipitation of carbon from solution in a metal solvent/catalyst. The supersaturation required for stable growth derives from the establishment of a small but reproducible temperature difference, top to bottom, within the high pressure zone. The equipment must be capable of maintaining stable synthesis conditions for long times, often more than 200 hours.

## References

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