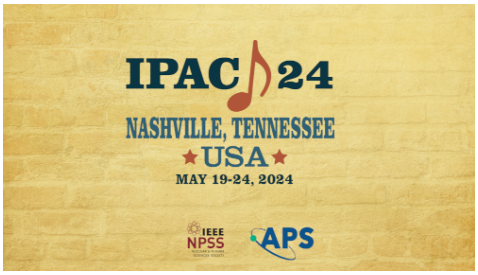

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High-quality dislocation-free diffraction grade HPHT diamond substrates for next-generation of synchrotron and FEL X-ray sources

Tuesday, 21 May 2024 16:00 (2 hours)

Next-generation of synchrotron and FEL X-ray sources will increase the peak power by several orders of magnitude. In these conditions, X-ray intensity will become too severe for the existing materials. Large, single-crystal diamond is one of the few materials suitable for X-ray optical applications due to its unique combination of physical properties. We developed the modified High-Pressure High-Temperature (HPHT) temperature gradient growth technology that allows the growth of the highest crystalline quality large diamond crystals with a dislocation density of less than 10 cm-2. This near-equilibrium process is carried out under extreme conditions, where diamond single crystals are grown from a molten metal solvent under 5 GPa pressures and temperatures of 1,600 K. We present results from a collaboration that includes experimental growth carried out at the Euclid Beamlabs, modeling efforts by the University of Minnesota and Fraunhofer IISB, and X-ray crystals characterization conducted by APS/ANL. This three-fold approach provides rigorous tools to both understand growth in this system and to perform subsequent optimization of growth conditions of diffraction-grade diamonds.

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