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NEWS FROM RESEARCH

Transparent, Faceted Nano-Polycrystalline Synthetic Diamond

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Synthetic nano-polycrystalline diamond (NPD) may be one of the biggest developments in synthetic diamond production in recent years. This new, highly transparent, brownish yellow material is not produced by CVD or traditional HPHT diamond synthesis methods, but is created in a multi-anvil press by a sintering process which converts graphite to diamond at 15 GPa and 2300-2500°C (see G&G Su2012 p. 128-131). While this material shares many visual properties with natural and synthetic single crystal diamond, it also has properties that are unique enough for gem laboratories to separate with careful testing.

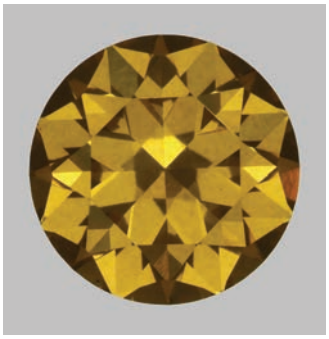

Figure 1. This 0.88 carat synthetic nano-polycrystalline diamond was grown using a multi-anvil press by a new sintering process and faceted into a round brilliant stone. Photograph by Rob McMurtry.

Based on preliminary examination of the faceted stone shown in Figure 1, we noted the following features: slight haziness seen in the face up position, numerous pinpoint type inclusions, and a roiled appearance (Figure 2). While these visual features seem to be unique to this new material, they should not be considered diagnostic. Fluorescence imaging of this stone using the Diamond View showed red luminescence with an unusual pattern (Figure 3). This material has also proven to be spectroscopically distinct and different from natural diamonds when absorption spectra from the Vis-NIR and Mid-IR regions were examined (Figures 4 and 5). Although it may take some time for this new material to reach the market, its unique properties should be readily identifiable with routine laboratory testing. A complete gemological and spectroscopic characterization is underway by gemologist Elise Skalwold in collaboration with researchers at the GIA laboratory and will appear in an upcoming issue of Gems & Gemology.

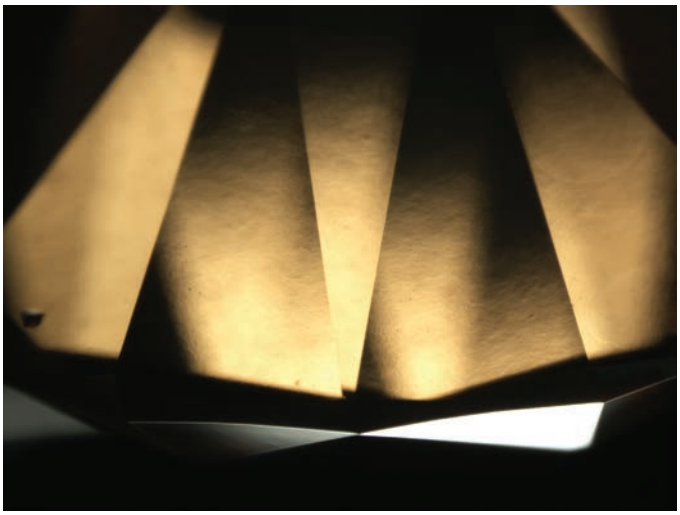

Figure 2. This new type of synthetic diamond showed a roiled appearance when examined under magnification. Photomicrograph by Nathan Renfro. Magnification 25×.

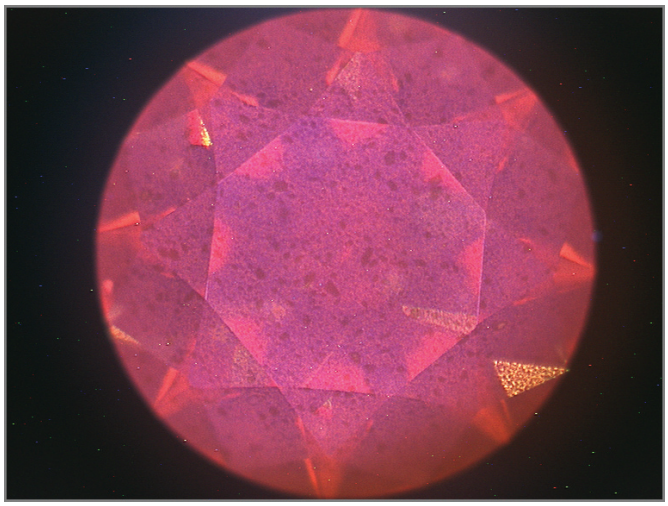

Figure 3. A fluorescence image taken with the DiamondView instrument (<220 nm UV excitation) showed a dominant, but unusually patterned, red luminescence. Image by David Nelson.

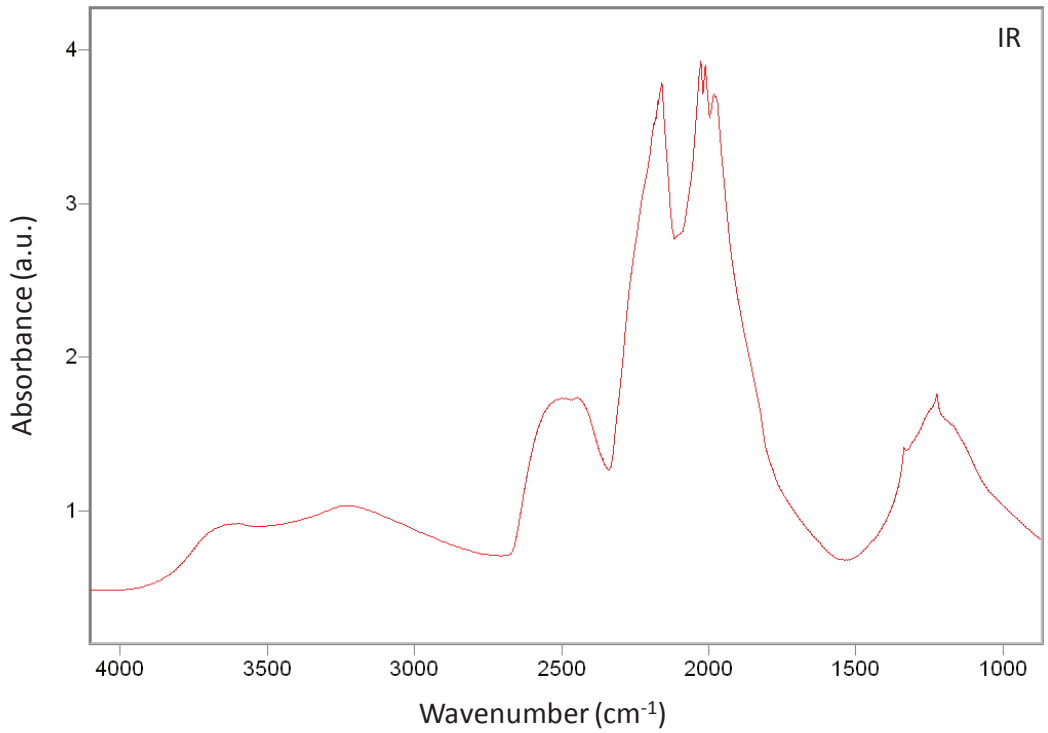

Figure 4- The mid-infrared spectrum of the NPD material showed clear absorptions that are characteristic of diamond (~4000 to 1500 cm-1). However, absorption in the one-phonon region (~1500-800 cm-1) is not consistent with any known impurities seen in natural diamond.

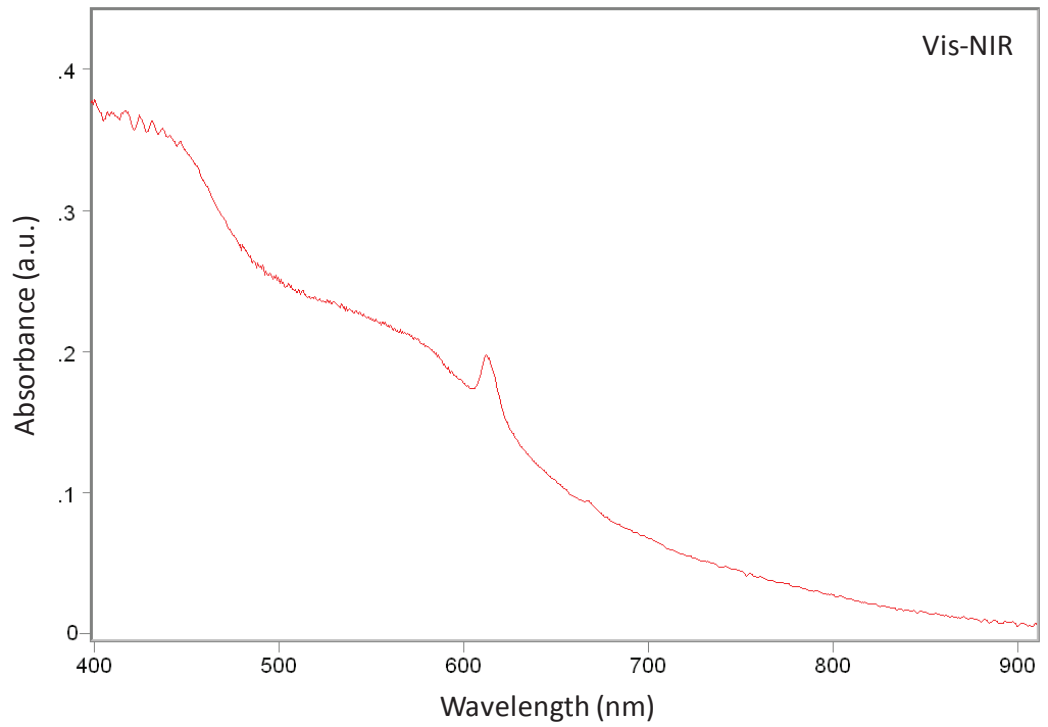

Figure 5-The Vis-NIR spectrum of the nano-polycrystalline diamond, collected at 77 K, showed unusual absorption features at ~612 and 668 nm of currently unknown origin.