IDENTIFYING SYNTHETIC DIAMONDS

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Synthetic diamonds have the same physical and optical properties as natural diamonds; however, they have distinct gemological and spectroscopic properties that distinguish them as laboratory grown. A number of properties reveal diagnostic features, such as inclusions and growth sectors, luminescence to ultraviolet light, cathodoluminescence, anomalous birefringence, and mid-infrared and visible spectra. Differences in growth rates and mechanisms between synthesis and natural crystallization underlie these features. In nature, diamond growth proceeds chiefly along {111} and yields well-developed octahedral sectors, and little if any growth in other sectors. In contrast, commercial diamond synthesis using a metallic flux produces growth along {100} as well as {111}, leading to strong development of cubic sectors and lesser development of dodecahedral and trapezohedral sectors. A property gemologists call graining (which is usually composed of optically visible defects of crystallization or plastic deformation aligned along crystallographic planes and interfacial junctions), and the patterns of ultraviolet fluorescence and cathodoluminescence reveal these growth sectors. Near colorless synthetic diamonds luminesce weakly, but they exhibit a blue-to-green afterglow to short-wave ultraviolet light. Uneven incorporation of chromophores in different sectors leads to characteristic zonations of color in colored synthetic diamonds. Natural gem diamonds usually exhibit anomalous birefringence in characteristic patterns, but synthetic diamonds rarely show any similar effects in polarized light. Natural diamonds typically contain one or more forms of aggregated nitrogen, with known absorption peaks in mid-infrared and visible spectra. Nitrogen is incorporated in synthetic diamond as single substitutional atoms, and even with significant post-growth heat treatment forms only A aggregates.