GIA®

RAPAPORT GEMTALKS

Laboratory-Grown Diamonds

Review and Outlook

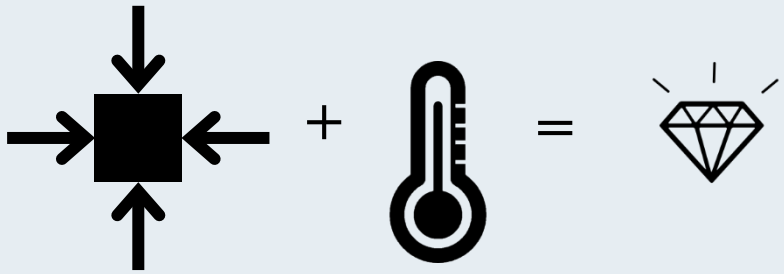
Growth Methods

Main Growth Methods

~20%

HPHT =

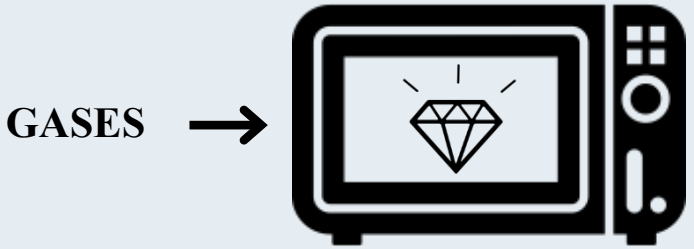
High-Pressure, High-Temperature



~80%

CVD =

Chemical Vapor Deposition

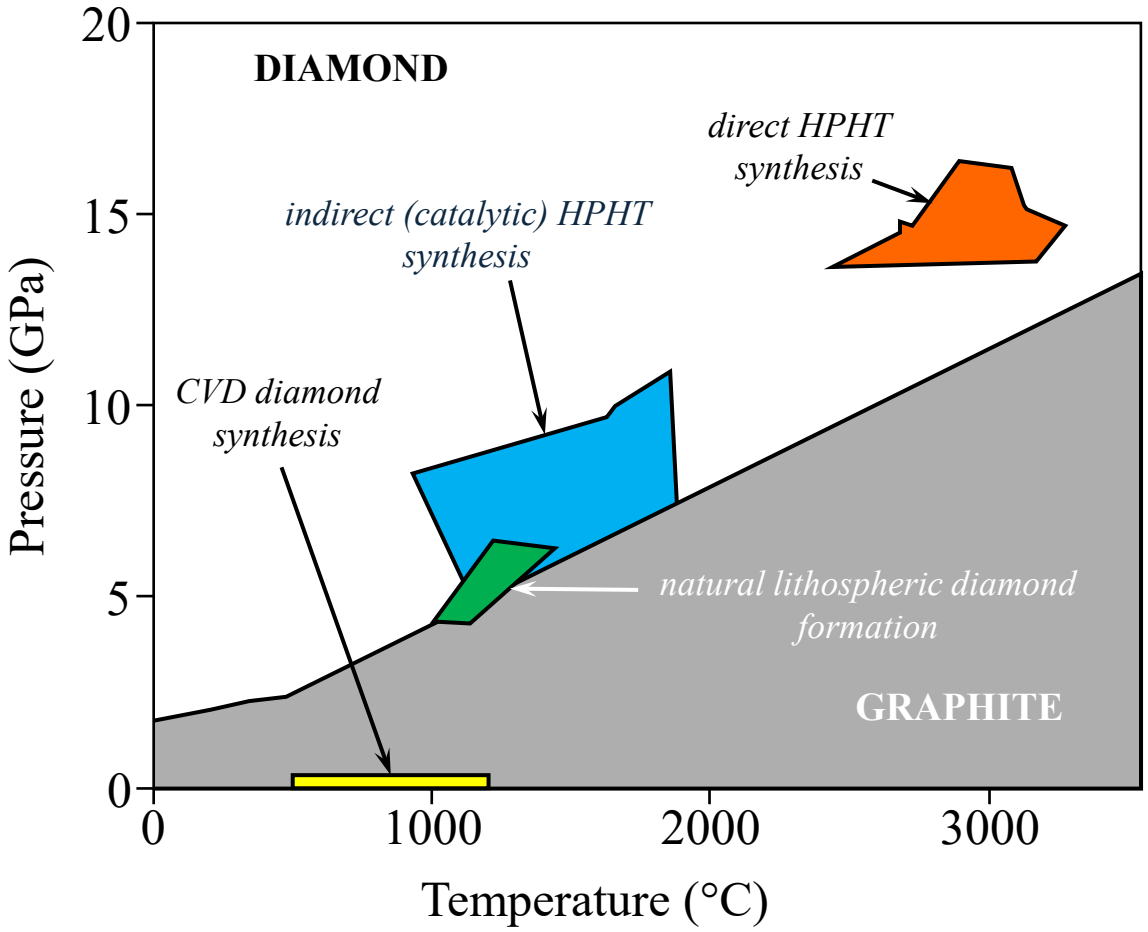


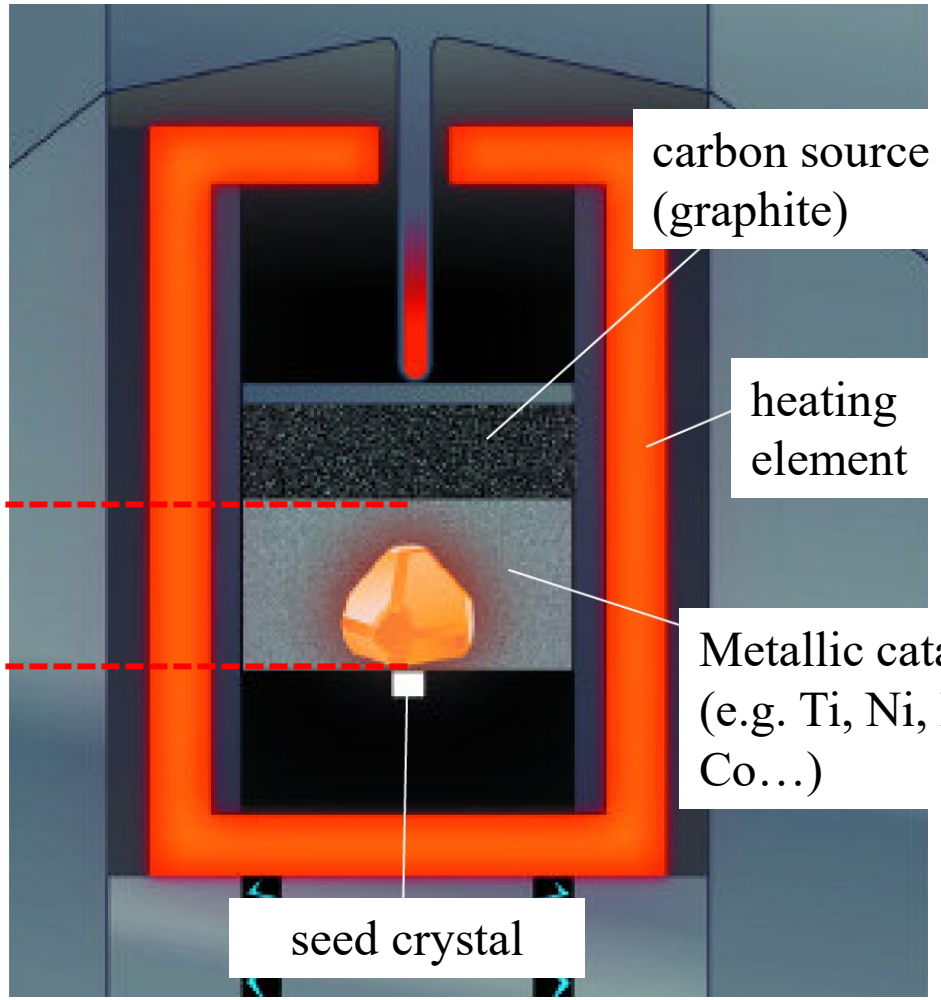
Yesterday's Laboratory-Grown Diamonds

Early HPHT-grown gem products

Early CVD-grown gem products

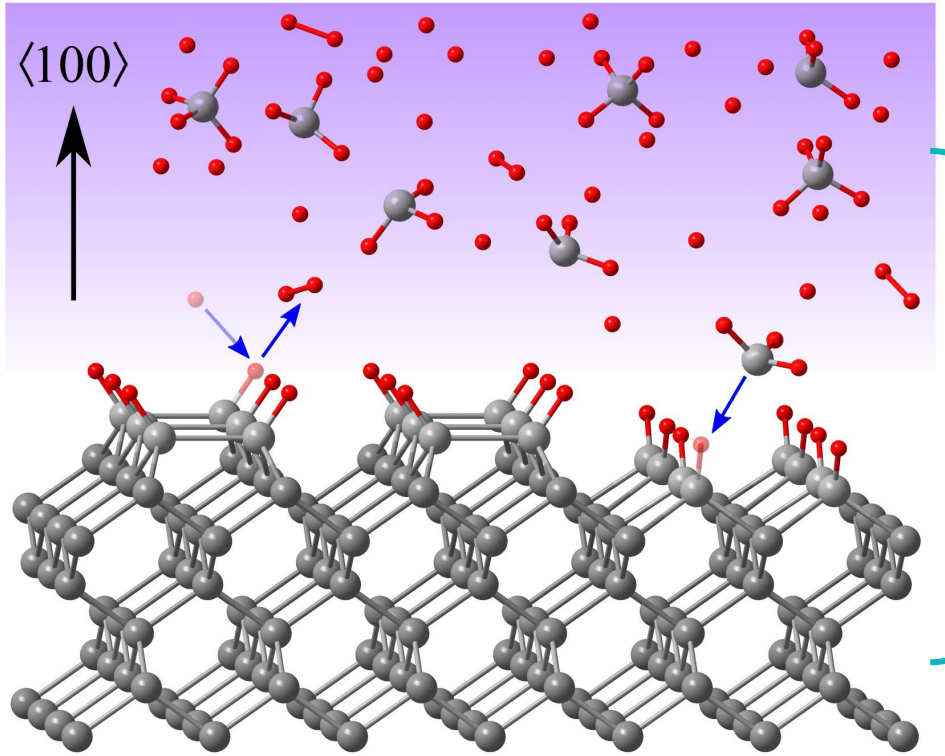
HPHT Diamond Growth

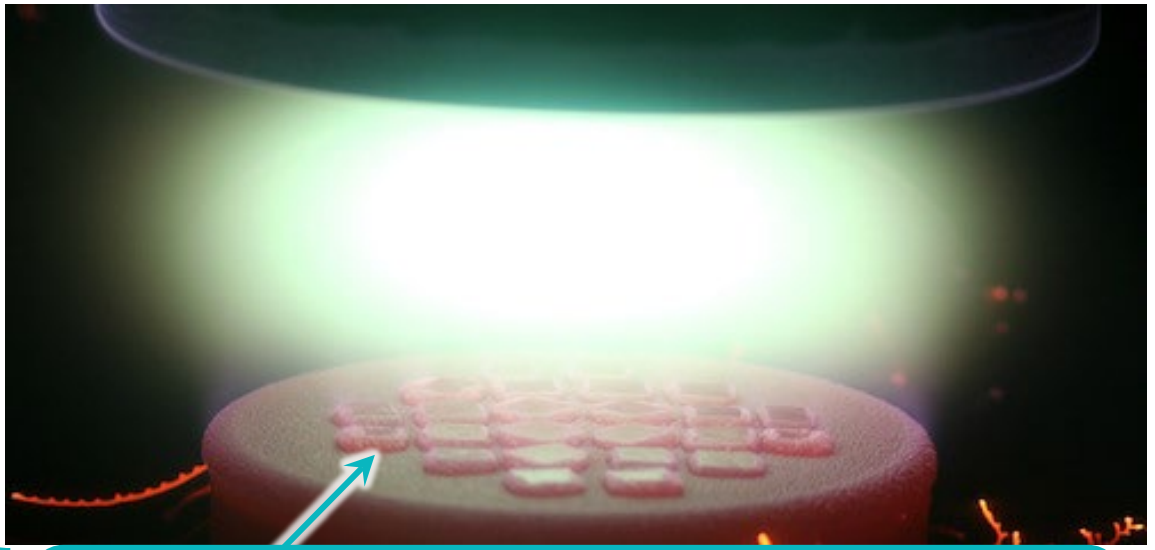




T1 – T2 = ~30°C

CVD Diamond Growth



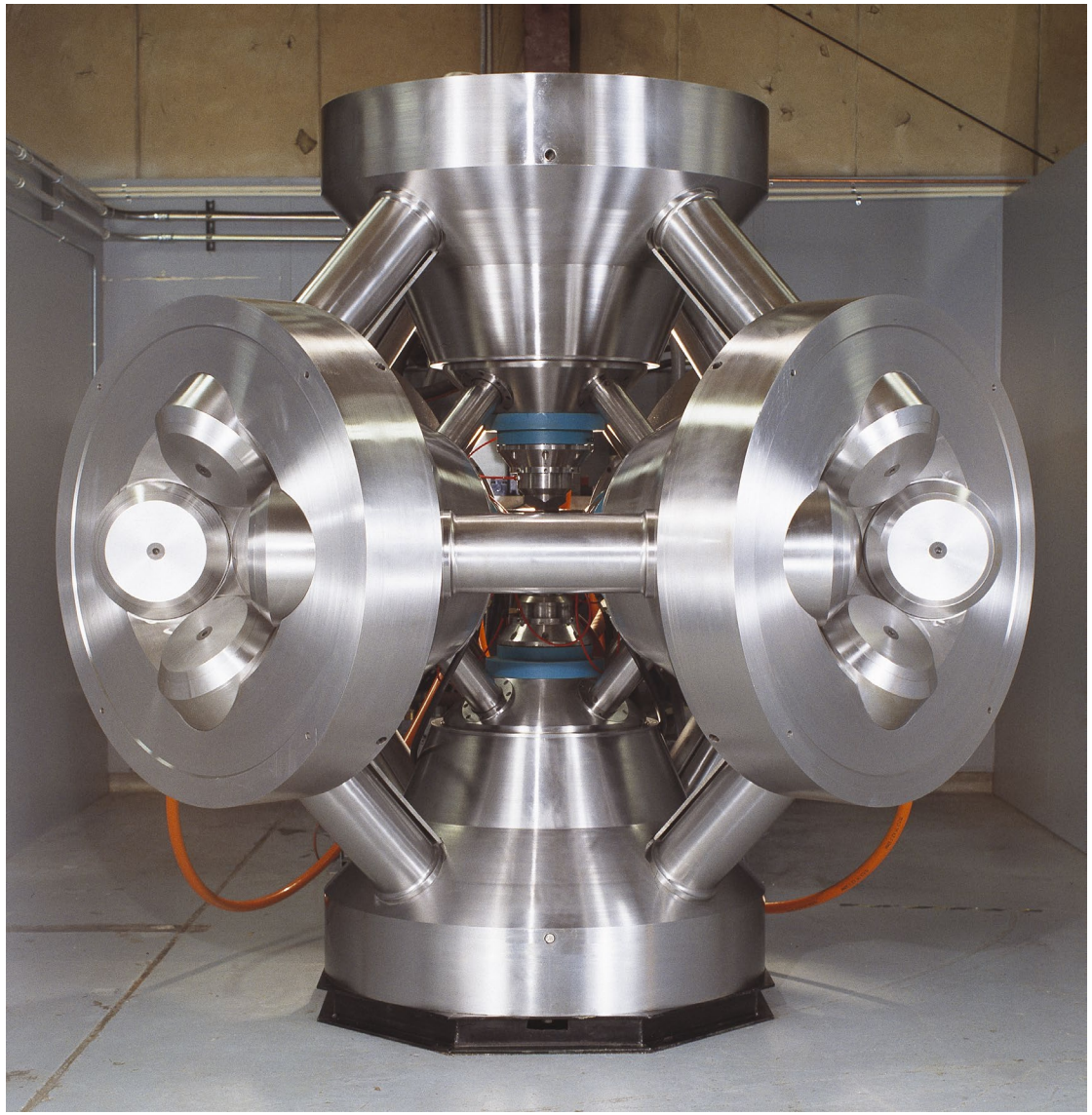


Substrate
+
CVD Laboratory-Grown Diamond

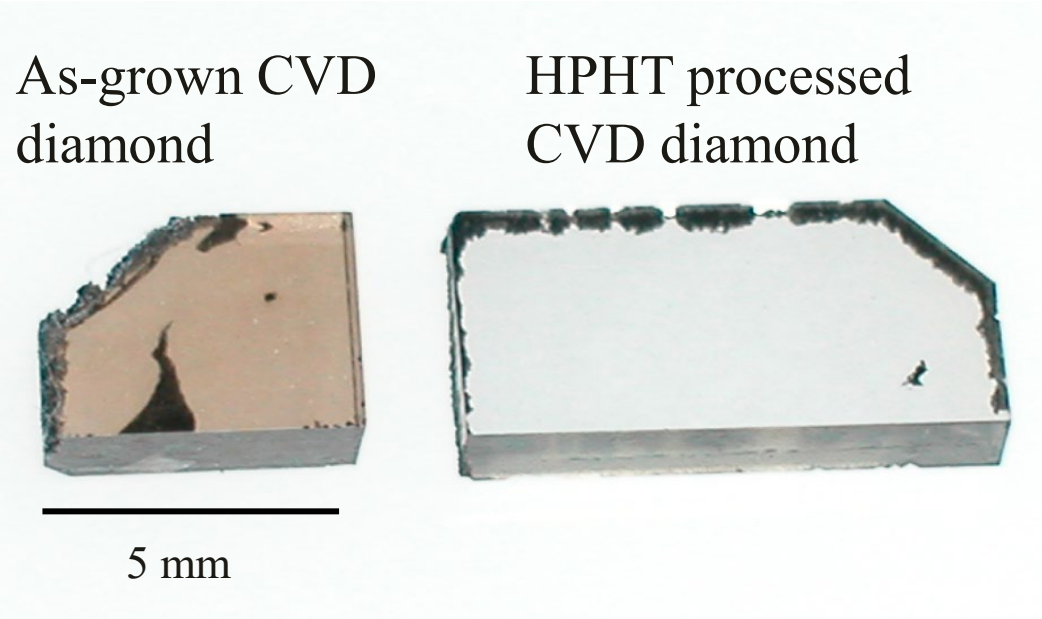
- Hydrocarbon gas (methane) in 99% hydrogen gas
- Pressure ~10–200 torr (1/20–1/4 atm)
- Temperature ~700–1200 °C
- Duration ~days – week
- Growth rate 2–50 µm/hour

HPHT Treatment of CVD Diamonds

- HPHT diamond growth
  - Pressure ~5–6 GPa
  - Temperature ~1300–1600°C
- CVD diamond growth
  - Pressure ~2–20 kPa
  - Temperature ~800–1100°C
- **HPHT processing**
  - Pressure ~4–7 GPa
  - Temperature ~1700–2100°C
  - CVD-grown and natural diamonds (not common for HPHT-grown)



HPHT Treatment of CVD Diamonds

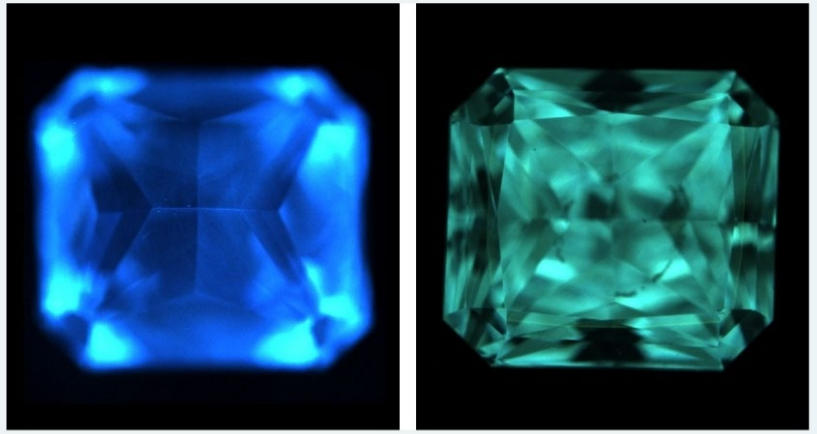


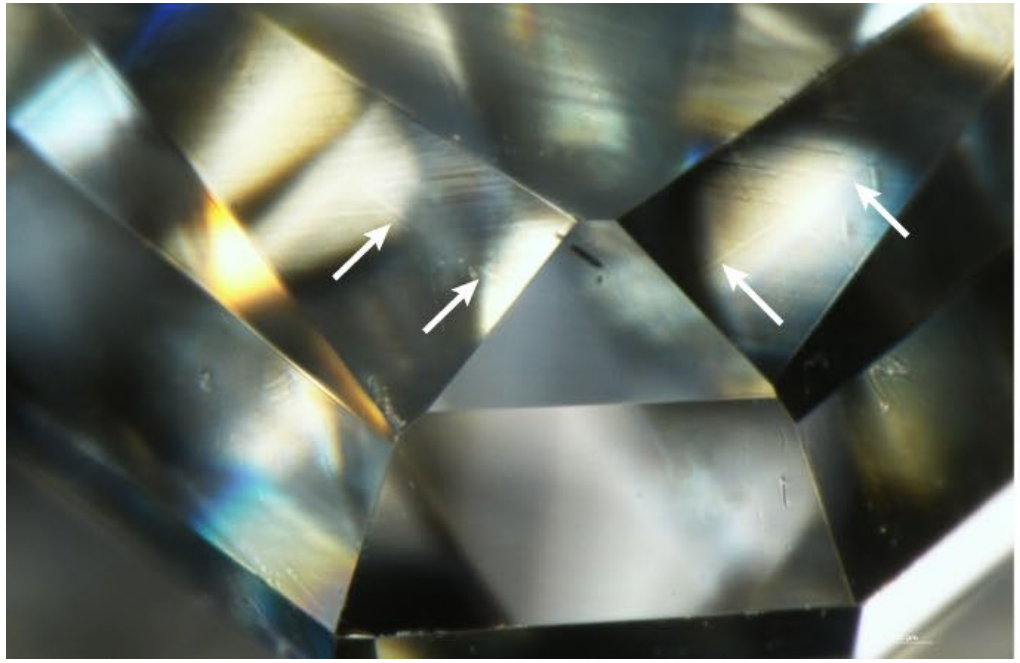
0.59 ct Fancy light gray

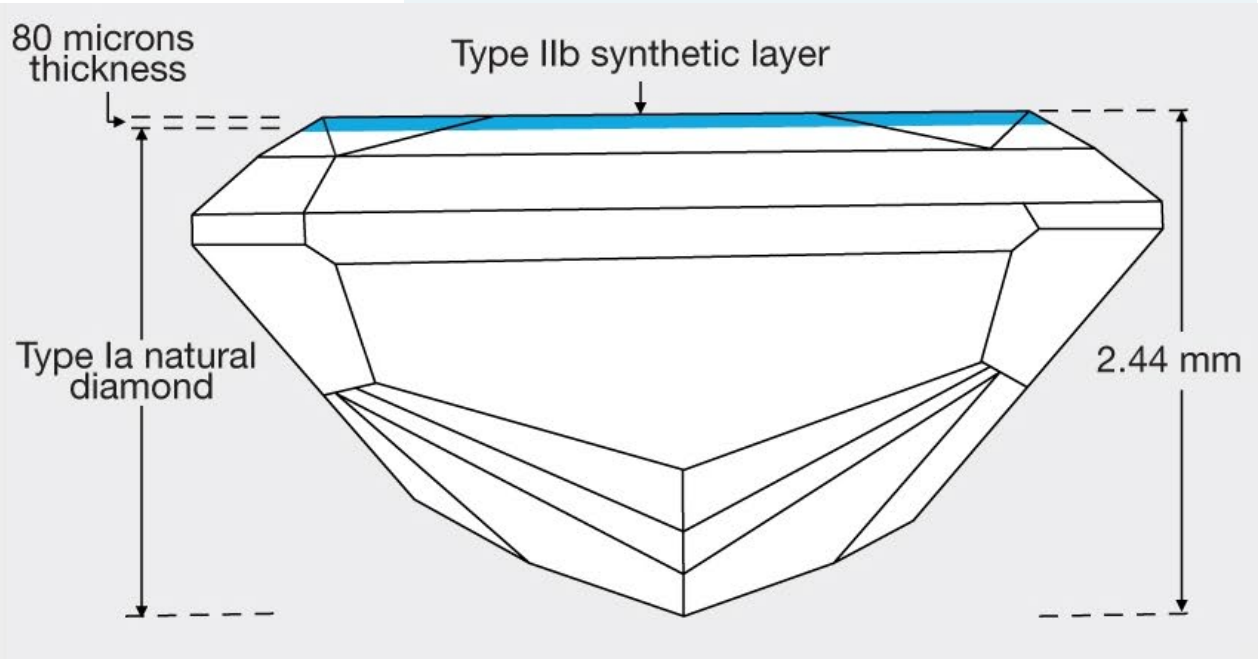
- As-grown CVD diamond
  - Light brown color due to defects
  - HPHT processing removes brown so it turns near-colorless
- Only ~20% near-colorless submitted as-grown
  - ~80% near-colorless were HPHT processed
- HPHT processed CVD-grown diamonds can be gray
  - Receive a Fancy gray color grade instead of a D-Z grade

CVD Overgrowth on Natural Diamond

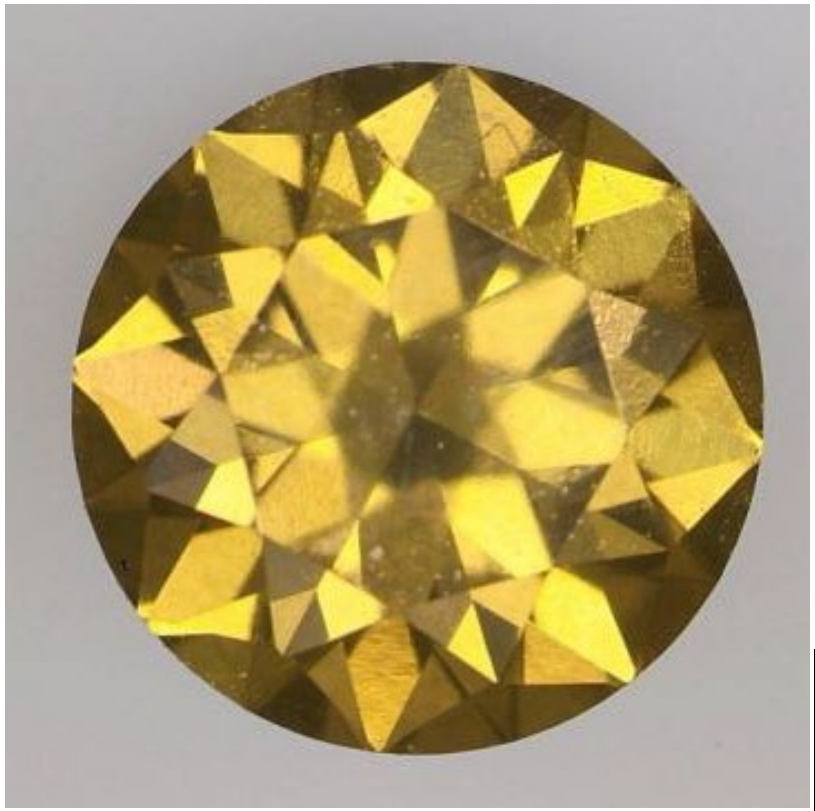
Fancy Blue
0.33 ct







Alternative Growth Methods



Skalwold et al., Fall 2012
Gems&Gemology

Nano Polycrystalline Diamond (NPD)

- Fancy Deep brownish yellow
- 0.88 ct
- Produced at very high pressure, high temperature (15 GPa, 2300-2500°C)

Gemological properties include tatami strain and non-diamond carbon inclusions