Fraunhofer IAF

Diamond epitaxy

Synthetic diamond for quantum technologies

Ultrapure diamond made at Fraunhofer IAF
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Due to the incredibly rigid structure of diamond, the quantum effects of color centers incorporated within the crystal can be observed and harnessed close to room temperature in contrast to e.g., superconducting circuits that form the qubits in state-of-the-art quantum computers operating in cryogenic conditions.

Fraunhofer IAF has developed outstanding competences in growth of ultrapure and nitrogen-doped diamond substrates as well as thin films in a highly controlled manner. Quantum properties of these materials can be further pushed to their limits by controlling the diamond isotopic ratio, i.e., controlling the amount of nuclear spins.

Diamond properties

- Refractive index: 2.4
- Optical window: 300 nm to 2.5 µm and 7 to > 100 µm
- Density: 3.51 g/cm³
- Thermal conductivity: 2600 W/mK
- Hardness: 10000 HV

Doping of diamond

- Nitrogen for NV generation
- Boron for p-type diamond
- Phosphorous for n-type diamond

10.000
Vickers hardness of diamond

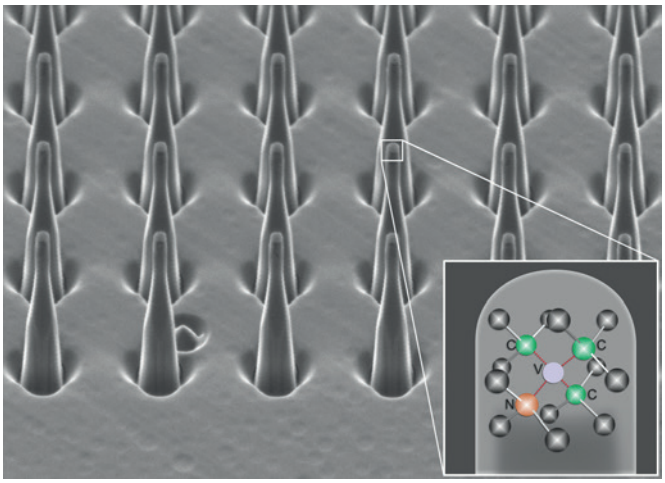
More information:

Diamond as a platform for atomic scale sensors

The nitrogen vacancy (NV) center is a point defect in diamond which exhibits an optically accessible spin system with extraordinary coherence times under ambient conditions. Owing to its minute size, the NV center can be used to measure magnetic fields on the nanometer scale, e.g., originating from currents in microelectronic circuits or magnetic nanostructures. For such measurements, single NVs are positioned in tip-shaped microstructures that are scanned over the sample of interest.

Diamond technology

- Electron-beam lithography
- Laser lithography
- Reactive ion etching
- Metallization



Microstructures fabricated by IAF clean room technology containing an atomic scale sensor, the NV center
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Diamond epitaxy equipment

For diamond epitaxy Fraunhofer IAF runs in total 10 plasma reactors:

- 7 reactors covering a 80 mm diameter area
- 3 reactors covering a 150 mm diameter area

The reactors are equipped with purified gases to obtain contamination-free diamond and dopant gases to alter diamond properties.

Diamond growth reactors at IAF for diamond films tailored to quantum devices
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