

Technical Notes:

Radiation & Particle Detectors from CVD Diamond

Diamond Grades:

- SingleCrystal (MonoCrystalline) High Purity
- SingleCrystal (MonoCrystalline) 3A
- PolyCrystalline ELS (Electronic Grade Standard)
- PolyCrystalline ELP (Electronic Grade Premium)

Diamond Grade: SingleCrystal (MonoCrystalline) High Purity

- capable of energy resolution (type, level), a/k/a "spectroscopic grade"
- XY: 'as grown' SC is 4.7 mm +/- 0.2 mm [x] 4.7 mm +/- 0.2 mm
- SC can be tiled (tessellated) to make larger area SC detectors
- SC can be trimmed (cut down) to make smaller area SC detectors
- Z: 'as grown' SC is 500 um thick
- SC can be thinned to 0.05 mm / 50 um

Diamond Grade: SingleCrystal (MonoCrystalline) 3A

- nitrogen-doped (to <1 ppm)
- faster response than SCHP material for equal thickness
- requires higher energy/signal than SCHP material
- not spectroscopic

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TechNotes on Radiation & Particle Detectors from CVD Diamond (2p6)

Diamond Grade: PolyCrystalline ELS (Electronic Grade Standard)

- detects presence of radiation (eg contamination), but cannot distinguish type
- XY: 'as grown' PC is 50 x 50 mm (formerly 10 x 10 mm)
- PC can be trimmed (cut down) to make smaller area PC detectors
- Z: 'as grown' PC is 150 um thick; can be grown to 1000 um / 1 mm thick
- PC can be thinned to 0.10 mm / 100 um

Diamond Grade: PolyCrystalline ELP (Electronic Grade Premium)

- physical dimensions (etc) as ELS (above)
- longer growth period results in larger grains
- larger grains result in fewer grain boundaries
- fewer grain boundaries result in fewer holes lost in boundary areas
- responsivity better than PolyCrystalline ELS, less than SingleCrystal

Thickness & Thinning:

- thinning improves transmission by reducing absorption (effect varies by particle type)

Polishing Surfaces:

- P1: polish growth side only; coarse & fine lapping
- P1N: polish nucleation side only; fine lapping only
- P2: polish both growth & nucleation sides
- default polishing is P1
- ASK for application-specific advice ... custom requirements welcome!

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TechNotes on Radiation & Particle Detectors from CVD Diamond (3p6)

Polishing Standards:

- PolyCrystalline Standard Polish: $R_a < 30\text{nm}$
- PolyCrystalline Detector Polish: $R_a < 12\text{nm}$
- PolyCrystalline Super Polish: $R_a < 5\text{nm}$
- SingleCrystal Detector Polish: $R_a < 5\text{nm}$
- ASK for application-specific advice ... custom requirements welcome!

Electrodes:

- typical design is "sandwich": a single diamond layer is metallized on top & bottom
- ASK about side-mounted electrodes, etc ... custom requirements welcome!

Metallization:

- typical metallization is TiPlAu
- 5 μm Ti - forms TiCarbide & gives good adhesion
- 20 μm Pl - barrier layer deposited under vacuum, prevents oxidation & amalgamation
- 200 μm Au - could be thicker but begins to absorb, eg, alpha particles
- ASK about TiWAu, Aluminum, etc ... custom requirements welcome!

Packaging:

- typical packaging is SMA assembly (double-ended, single-ended)
- double-ended advantage: diamond detector is isolated to the two center pins
- common alternatives include BNC, TO-Metal Can, COB (Chip On Board), etc
- drawings & pictures of packaging alternatives are available upon request
- ASK for application-specific advice ... custom requirements welcome!

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TechNotes on Radiation & Particle Detectors from CVD Diamond (4p6)

Electronics:

- typically CFE (Customer-Furnished Equipment); design issues include:
- voltage applied across CVD Diamond piece/layer
- $0.5 < vdc < 1.0$ per micron of thickness
- example: could apply even 500 vdc across max 500 um / 0.50 mm thick SC
- high(er) voltage enables fast(er) detection, eg, N00 ps
- low capacitance of CVD Diamond contributes to sensitivity

Signals:

- diamond can generate one electron hole pair for every 13eV incoming
- for some applications, this can be a very small number of holes
- our supplier offers a pre-amp to support these detectors
- the pre-amp has supported response times as fast as 38 ps

Related Products:

- diamond optical windows, thermal bridges
- boron-doped diamond bio/chemical sensors/electrodes/probes

Questions?

v101206

להביא טכנולוגיות מתקדמות לאנשים שמשתמש בהם

02.583.2511 (ט)

02.583.2512 (פ)

51.156.116.9 (ע"מ)

פז"מ-טק (1991) בע"מ

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