Investigation of Detector Properties of Diamond-on-Iridium Sensors

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Iridium substrate provides high-density and highly ordered nucleation. The crystallites are converging and the Boundaries are mostly gone after some 10th um growth => (should be) close to single crystal material
Samples

Produced at Augsburg University
http://www.physik.uni-augsburg.de/de/lehrstuehle/exp4/Arbeitsgruppen/diamant/

MFDia954: 4.94x4.96mm x 290µm, metallisation: 50nm Ti, 90nm Pt, 100nm Au (Ø3mm)

MFDia886-2: 3.49x3.5mm x 324µm, metallisation: 100 nm Al
MFDia953: 4.9x4.95mm x 280µm, metallisation: 100 nm Al

Bonding to Al metallisation problematic
We were able to properly contact only MFDia886-2
And only with conductive glue
MFDia 954, IV measurements

Current spike corresponds to increased noise, CCE measurements are difficult above 250V.
CCE Measurements

Standard CCE setup with Sr source. Modes: Constant HV – constant high voltage applied
Alternating voltage – HV applied as a square wave
Frequency 1 – 0.1 Hz. This allows to suppress polarisation effects due to deep traps. (there is a significant difference for poly and damaged mono crystals.)

Presence of pumping effect was checked by irradiating the sample with Sr source for ~ 12 hours (~1-2Gy)
MFDia 954, CCE measurements

- Depumped by UV for 30 min
- Pumped by Sr source for ~ 12 hours
- Alternating voltage: Square waves @ 0.1 Hz

CCE ~ 50%, almost identical results for all measurement modes =>
No visible polarisation effects, low concentration of deep level traps?

Talk @ CARAT suggests different carrier collection eff., check with alpha
Test with $\alpha$-source

Am-241 alpha source was used. Small pinhole collimator. Selftriggered, threshold to suppress noise. Alt HV to suppress possible polarisation effects.

- Electrons

\begin{align*}
50V & \quad 100V & \quad 200V & \quad 300V & \quad 400V & \quad 500V
\end{align*}

- Holes

16-Dec-13
Transient current technique.

**MFDia954, diamond on iridium, 290um**

- Holes
- Electrons

- Voltage, V
- Time, ns
- 500V

Better transport by holes
Shape is not clear

**SCVD**

- SC1150, 385um, electrons
- SC1150, 385um, holes
There is some difference in CCE between the pads. But the saturated CCE value is ~50% for all pads. High noise is only visible for pad 4.
MFDia 886-2

CCE ~ 25%
Saturates around 200V
Slightly asymmetric
No noise visible upto 500V
Signal comparison

~ same field strength
Single crystal
CCE ~ 100%

MFDia 954
CCE ~ 50%

E6 poly
CCE ~ 40%

16-Dec-13
Conclusions

• CCE is on the level of best E6 poly.
• Better homogeneity than poly.

• Holes are better for charge transport
• No significant pumping and polarisation effects (should mean something in terms of trapping levels)

• Getting more samples and more statistics would be great
• Is it possible to produce larger samples – 10x10mm? more?

Thank you