

Signal Behaviour of Poly-Crystalline CVD Diamonds on Incident Particle Flux

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We have measured the signals in poly-crystalline Chemical Vapour Deposition (CVD) (pCVD) diamonds induced by incident charged particles for fluxes from 5 kHz/cm² up to 20 MHz/cm². It was found that the signals of irradiated pCVD diamond detectors, show no variation greater than 2 % up to the maximum flux. This was measured for irradiations with fast reactor neutrons with fluences ranging from 5 · 10¹⁴ n/cm² up to a maximum of 8 · 10¹⁵ n/cm².

Keywords: diamond, poly-crystalline diamond, CVD diamond, particle detector, pad detector, rate behaviour

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Discussion of the Pad Rate Paper**RD42 Analysis Meeting****Michael Reichmann**

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Section 1

Introduction

Introduction + Content

- detector fabrication
 - ▶ cleaning
 - ▶ RIE
 - ▶ photo-lithography
 - ▶ metallisation
 - ▶ pre-tests with source
 - ▶ amplifier
- setup
 - ▶ HIPA PSI stats
 - ▶ piM1 stats -> site plan + collimators
 - ▶ beam telescope specs
 - ▶ DAQ & Trigger

Section 2

Measurements

Measurements

Name	S [mm]	T [μm]	CCD [μm]	Irr _{max}
poly-b2	$\sim 5 \times 5$	455	?	$8 \cdot 10^{15}$
poly-97	$\sim 5 \times 5$	510	?	$3.5 \cdot 10^{15}$

Table: Properties of poly-b2 and poly-97. S - lateral size, T - thickness, CCD - Charge Collection Distance, Irr_{max} - maximal irradiation.

	poly-b2	poly-97
August 2015	0	0
October 2015	$5 \cdot 10^{14}$	0
August 2016	$1 \cdot 10^{15}$	$5 \cdot 10^{14}$
October 2016	$2 \cdot 10^{15}$	$1.5 \cdot 10^{15}$
July 2017	$2 \cdot 10^{15}$	$1.5 \cdot 10^{15}$
August 2017	$4 \cdot 10^{15}$	$3.5 \cdot 10^{15}$
August 2018	$8 \cdot 10^{15}$	X

Table: Irradiations in n/cm^2 of the pCVD diamond detectors during the various beam tests.

- describe rate scan procedure

Section 3

Analysis

Analysis

- raw → root conversion
- event alignment
- tracking
 - ▶ physical alignment of the telescope
 - ▶ plane uncertainties
 - ▶ track building
- waveforms
- cuts
- rate dependence parameters

① **relative standard deviation** of all points x :

$$\sigma_{\text{rel}} = \frac{\sqrt{\frac{1}{N-1} \cdot \sum_{i=1}^N (x_i - \bar{x})^2}}{\bar{x}} \quad (1)$$

② **relative spread** between the highest and the lowest signal:

$$s_{\text{rel}} = \frac{x_{\text{max}} - x_{\text{min}}}{\bar{x}} \quad (2)$$

Section 4

Results

Results

- pedestal & noise
- signal
- uniformity
- rate studies
 - ▶ random scans
 - ▶ nonirradiated

Name	σ_{rel} [%]		s_{rel} [%]	
	+1000 V	−1000 V	+1000 V	−1000 V
poly-b2	1.1	1.8	4.5 ± 0.1	5.5 ± 0.1
poly-97	-	4.0	-	13.8 ± 0.1

Table: Results of the nonirradiated detectors.

B2 & 97 irradi

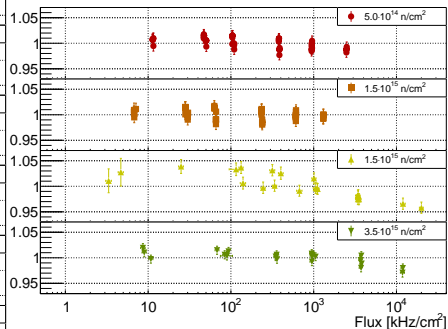
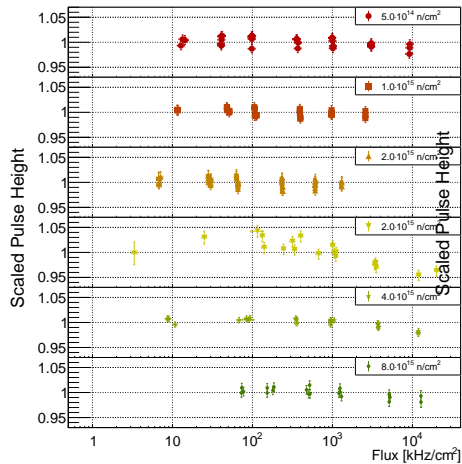
Irradiation [n/cm ²]	σ_{rel} [%]		s_{rel} [%]	
	+1000 V	−1000 V	+1000 V	−1000 V
$5 \cdot 10^{14}$	1.0	0.9	3.8 ± 0.1	3.6 ± 0.1
$1 \cdot 10^{15}$	0.8	0.7	2.9 ± 0.2	2.4 ± 0.2
$2 \cdot 10^{15}$	0.8	0.9	3.1 ± 0.2	3.3 ± 0.2
$2 \cdot 10^{15}$	1.0	2.3	4.2 ± 0.4	12.7 ± 2.1
$4 \cdot 10^{15}$	0.6	0.8	2.8 ± 0.3	3.0 ± 0.3
$8 \cdot 10^{15}$	0.7	0.8	3.0 ± 0.5	3.4 ± 0.5

Table: Results of the irradiated poly-b2 detector.

Irradiation [n/cm ²]	σ_{rel} [%]		s_{rel} [%]	
	+1000 V	−1000 V	+1000 V	−1000 V
$5 \cdot 10^{14}$	1.3	1.1	4.9 ± 0.2	4.0 ± 0.2
$1 \cdot 10^{15}$	1.6	1.0	5.5 ± 0.2	3.6 ± 0.2
$2 \cdot 10^{15}$	1.6	2.2	6.7 ± 0.4	8.1 ± 0.4
$8 \cdot 10^{15}$	1.3	1.1	5.2 ± 0.2	4.8 ± 0.3

Table: Results of the irradiated poly-97 detector.

97 & B2 @ -1000 V



Section 5

Conclusion

Conclusion

- empty
- moreempty
- moremoreempty

DEL FIN

