Results on timing properties of SCCVD diamond detectors for MIPs

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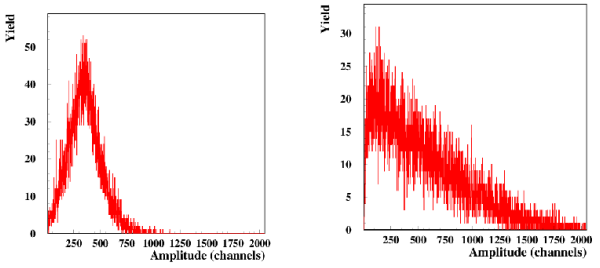
First encouraging results on timing performance of diamond detectors for MIPs were obtained using policrystal diamond detectors (PC) [1]. The timing properties of two single crystal diamond detectors (SCCVD-DD)with a thickness of 300 μm and 500 μm using a ^{90}Sr source and an applied electric field of $\sim$ 1 V/μm are presented in this report. The diamonds were placed in the collimated beam of beta particles, the reference signal being delivered by a NE102 plastic scintillator.

In the first measurements the signals delivered by the SCCVD-DD were amplified by fast amplifiers developed for multistrip multigap resistive plate counters (MSMGRPC) [2] and a FTA810L amplifier. The amplified signals of the SCCVD-DD and the signal of the plastic scintillator coupled with a phototube were split and processed for charge and timing information.

The start signals were delivered by the overlap coincidence between the signals of the diamond detector and the plastic scintillator. Fig.1 shows the charge distribuitions for the 300 μm thickness diamond detector (Fig.1a) and for the plastic scintillator (Fig.1b).



a) b)

Figure 1: Charge distribution for: a) 300 μm diamond detector and b) plstic scintillator

The obtained time of flight spectrum after walk correction can be followed in Fig 2a. Subtracting the contribution of the plastic scintillator of 125 ps, measured between two identical plastic scintillators coupled to identical phototubes, a time resolution of 147 ps is obtained.

The time of flight spectrum obtained using the SCCVD-DD of 500 μm thickness and the same experimental setup is shown in Fig.2b. The time resolution under this condition, after subtracting the contribution of the reference detector, was 214ps. In the second part of the measurements the signals delivered by the SCCVD-DD were amplified by a charge sensitive preamplifier (CSA) with a 0.7 ns rise

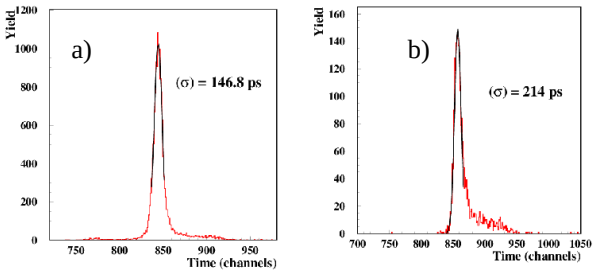


Figure 2: The time of flight spectra after walk correction: a) 300 μm and b)500 μm SCCVD-DD

time. The rest of the experimental setup was the same. The results are presented in Fig.3.

The time resolution obtained using the SCCVD-DD of 300 μm thickness and a CSA with 0.7 ns rise time is 374 ps, while for SCCVD-DD of 500 μm thickness a time resolution of 1.14 ns is obtained.

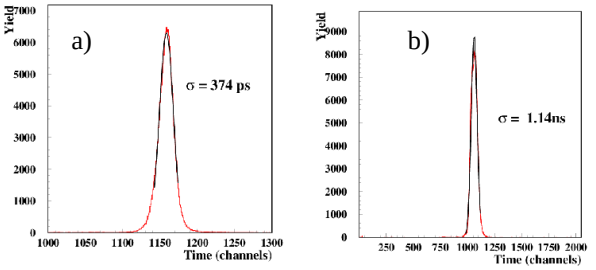


Figure 3: Time of flight spectra using charge sensitive preamplifier with 0.7 ns rise time: a) 300 μm abd b)500 μm SCCVD-DD

Based on the results presented in this report one could conclude that better results were obtained using the thinner detector for the same FEE used for the amplification of the signals delivered by the SCCVD-DD. Better performance in terms of time resolution gives the fast FEE electronics developed for MSMGRPC. Detailed efficiency studies and in-beam tests are in progress.

References

[1] M. Petrovici, E. Berdermann, M. Petriş, G. Caragheorgheopol, D. Moisă, NIPNE Scientific Report, 2001, p. 43

[2] M. Ciobanu, A. Schüttauf, E. Cordier, N. Herrmann, K.D. Hildenbrand, Y.J. Kim, Y. Leifels, M. Marquardt, M.Kis, P.Koczon, M. Petrovici, J. Weinert, X. Zhang, will be published