Synergy between Space related and High Energy Physics related research on radiation hardness of semiconductor materials demonstrated at the example of the AsBeST project

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Abstract:

Silicon carbide is a versatile wide-gap semiconductor material, that has besides automotive and space electronics also interesting applications for sensing in high energy physics experiments [1]. In the AsBeST project, that is regarding an important nuclear reaction in the nucleo-synthesis related to the big-bang, we designed high reverse voltage maintaining pin-type SiC diodes, implanted radioactive ^{7}Be atoms and measured its radioactive decay to ^{7}Li atoms with and without [2] high electric fields in the device region, where the ions have been implanted. This experiment has been inspired by an article of E. Segre and C. Wiegand in 1949 [3]. A necessary condition for the successful experiment is that the pin-diodes do not degrade due to the MeV ion implantation and maintain low reverse bias currents for prolonged periods of high applied voltages. In a first step we implanted non-radioactive ^{9}Be atoms into the SiC pin diodes, realized without our project, and for comparison also into commercial SiC and Si photodiodes. A fast check of the radiation hardness has been done by measuring the radiation induced current (RIC) during ion implantation. In this in-situ measurements similar degradation rates, have been found for bound materials. Comparing, however, the change of the dark characteristics, only minor changes have been observed for the SiC photodetector, while in the case of the Si photodiode a reverse bias current increase of several orders of magnitude has been observed. A detailed analysis of the radiation damage, using admittance spectroscopy and a complete photoelectric characterization of the Si And SiC photodiodes will be shown.

Conflicts of Interest

There is no conflict of interest.

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References

[1] Litrico G. et al. *J. Phys.: Conf. Ser.* **2018**, 1056, 012032.
[2] Santonastaso, C.; Casali, N; Di Benedetto, L.; Boldrini, V.; Buompane, R.; Canino, M.; Carrano, V.; Formicola, A.; Gialanella, L.; Laubenstein, M.; Neitzert, H.C.; Pieruccini, M.; Porzio, G.; Rubino, A. *Journal of Physics G: Nuclear and Particle Physics*, **2025**, *52*, 035101.
[3] Segrè, E.; Wiegand C. E. *Phys. Rev.* **1949**, 75, 39–43.