Radiation Effects in Wide Bandgap Materials

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Wide bandgap semiconductors (WBS) enable electronic devices to operate at high power, high frequency and high temperature. Moreover, many WBS are considered more radiation-resistant than conventional semiconductors such as Si or GaAs, making them interesting for applications in extreme radiation environments, such as space. However, radiation effects in WBS are usually very complex due to the diversity of the lattices of these compound crystals which often have nonequivalent lattice sites, mixed bonding schemes or different polymorphs. Moreover, the high mobility of point defects can promote the formation of extended defects.

Benefiting from the remarkable radiation resistance of GaN, we developed radiation sensors based on single GaN microwires [1]. Their potential for the detection of ionising radiation as well as their degradation upon high fluence ion irradiation will be discussed. Interestingly, radiation defects are not always a nuisance. Two examples will show how ion beams can be used to tune the electrical and optical properties of WBS. In MoO_3, the electrical conductivity can be controlled over several orders of magnitude by oxygen implantation [2]. In Ga_2O_3, irradiation defects interact with chromium dopants, promoting their optical activation [3, 4]. Such defect engineering strategies will allow novel processing techniques and device designs.

[1] D. Verheij et al., *Appl. Phys. Lett.* **118,** 193501 (2021).
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[3] M. Peres et al., *Appl. Phys. Lett.* **120**, 261904 (2022).
[4] D. M. Esteves et al., *Scientific Reports* **13**, 4882 (2023).