# Task Group Proposal: Multiscale Modelling of SiC Substrates

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## Abstract

This abstract presents the application and validation of Low-Energy Ion Implantation through two case studies involving advanced materials and characterisation techniques. The first case focuses on the integration of graphene [1], epitaxially grown on crystalline SiC by project leader, Łukasiewicz-IMiF, and its interface with p-type graphene. LEII is explored for controlling defect structures and charge compensation in SiC, enhancing the performance of semi-insulating-SiC-based planar Hall effect sensors, and addressing scientific debates regarding p-doped graphene on n-doped SiC homolayers for vertical PIN-diode applications.

The second case investigates the application of LEII in optimising material properties for microwave and millimeter-wave technologies, drawing on the expertise of QWED company [3]. Characterisation of material properties spans conventional methods and advanced electrical properties, utilizing a wide spectral range to capture time-resolved mechanisms. This includes the modelling of impurity-induced carrier distributions and the development of new process equations for the commercial software QuickWave [4], validated by GHz dielectric resonators [5]. QWED's state-of-the-art microwave-to-mmWave resonant test-fixtures, along with the modelling of anisotropy in permittivity and the temperature-dependent characterisation, support the integration of LEII into both material and device-level applications.

MODA&CHADA modelling activities are conducted in two steps: first, using full-wave electromagnetic modelling to calibrate experimental setups, and then extending the analysis to multiphysics phenomena such as charge transport and temperature effects. The results are disseminated through the Open Innovation Platform [6], with royalty-free multiphysics solvers being developed to enhance understanding and support the broader scientific community. This research showcases the potential of LEII in advancing the high-temperature performance and material properties of devices in cutting-edge applications.

## References

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