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## Profiling defect and charge carrier density in the $\text{SiO}_2/4\text{H-SiC}$ interface with Low-Energy Muons

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Silicon carbide (4H-SiC) is a wide-bandgap semiconductor with promising applications in high-power and high-frequency devices. An advantage of SiC is that it is the only compound semiconductor that has the ability to form native silicon dioxide ( $\text{SiO}_2$ ). The performance of SiC-based devices relies heavily on interface effects. However, characterization of oxidation-induced defects - both in the oxide and the semiconductor - is still challenging.

Low-energy muon spin spectroscopy (LE- $\mu$ SR) can probe regions very close to the surface and interface up to a depth of 160 nm in  $\text{SiO}_2/\text{SiC}$  structures and is sensitive to charge carrier and defect concentrations.

We have studied  $\text{SiO}_2/\text{SiC}$  interfacial systems with thermally grown and deposited oxides using LE- $\mu$ SR. The thermal  $\text{SiO}_2$  has higher structural order, as indicated by the undisturbed muonium ( $\text{Mu}^0$ ) formation. However, the oxidation process leads to strain in the oxide and to band-bending at the SiC-side of the interface, which affects the SiC faces differently: i) at the (0001) Si-face the results can be explained by the depletion of electrons at the interface and ii) at the (000 $\bar{1}$ ) C-face a carbon-rich n-type region contributes to the increase of the diamagnetic fraction due to  $\text{Mu}^-$  formation.

Further investigations have been conducted to understand the passivation effects of state-of-the-art post-oxidation annealing (POA) processes on the  $\text{SiO}_2/\text{SiC}$  interface. Particularly, POA in an NO environment leads to an increase in charge carrier concentration near the interface, likely due to N acting as a dopant, which can be quantified based on the measured diamagnetic fraction.

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