**Challenges and perspectives in r-GeO2 heteroepitaxy**

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The ultra-wide bandgap semiconductor rutile germanium oxide (Eg = 4.6 eV) has the potential to rapidly become the new big actor in the field of power electronics.[1] In comparison with the widely investigated β-Ga2O3, a major potential advantage of r-GeO2 is the predicted possibility to obtain ambipolar doping for *pn* homo-junctions device architectures.

Experimentally, it has been already demonstrated its bulk growth with controllable n-type conductivity (Sb).[2] While this opens up for the future evolution of homoepitaxy, at present bulk r-GeO2 substrates are not commercially available; therefore, the development of this material system must rely on heteroepitaxy. Its epitaxial growth faces two major challenges: (1) the two-step growth kinetics involving the preliminary formation of the volatile GeO suboxide (limiting its growth rate)[3] and (2) the strong competition between the amorphous material and the rutile phase stabilization.[4] In this work we cover such aspects by investigating r-GeO2 epitaxial layers deposited by MOVPE on different orientations of isostructural r-TiO2 substrates. By combining experimental (e.g., (S)TEM, SEM, XRD, AFM, EBSD) and theoretical data we will focus on strain, faceting and growth rate in defining the overall structural quality of the deposited epilayers.

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