**Title**: "Insulators for 2D Nanoelectronics"

**Abstract:**

Despite the breathtaking progress already achieved for 2D electronic devices, they are still far from exploiting their predicted performance potential. This is in part due to the lack of scalable insulators, which would go along with 2D materials as nicely as $SiO_2$ goes with silicon. As a result, there is still no commercially competitive 2D transistor technology available today.

The selection of suitable insulators for 2D nanoelectronics represents an enormous challenge. However, this problem is of key importance, since scaling of 2D semiconductors towards sub-10nm channel lengths is only possible with gate insulators scalable down to sub-1nm equivalent oxide thicknesses (EOT). In order to achieve competitive device performance, these insulators need to meet stringent requirements regarding (i) low gate leakage currents, (ii) low density of interface traps, (iii) low density of border insulator traps and (iv) high dielectric strength.

The insulators typically used for 2D electronic devices are amorphous 3D oxides known from Si technologies ($SiO_2$, $HfO_2$, $Al_2O_3$), while native 2D oxides ($MO_3$, $WO_3$ and $Bi_2SeO_5$), layered 2D crystals (hBN, mica) and ionic 3D crystals ($CaF_2$ and other fluorides like $SrF_2$, $MgF_2$) have received increasing attention. 3D oxides form poor quality interfaces with 2D semiconductors and contain border traps which severely perturb stable device operation. Native oxides, on the other hand, are often non-stoichiometric due to the lack of well-adjusted oxidation methods and thus have a limited dielectric stability and inherently narrow bandgaps. As the most popular candidate, the layered 2D insulator hBN forms excellent van der Waals interfaces with 2D semiconductors, but has mediocre dielectric properties resulting in excessive leakage currents for sub-1nm EOT. The potential of other 2D insulators (e.g. mica) is currently unclear, in part due to the absence of scalable growth techniques. Finally, very promising insulators for 2D electronics are 3D ionic crystals like $CaF_2$ which form well-defined interfaces to 2D channel materials. In contrast to hBN, fluorides have good dielectric properties and thus exhibit low gate leakage currents. This talk will address the current state of the art and summarize the main problems together with potential solutions.