Advanced electron microscopy of WBG semiconductors and their heterostructures with 2D materials

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The talk will cover the heteroepitaxy of wide bandgap III-nitrides and show how microscopy could contribute to the development of GaN based devices which brought the revolution of LED lighting. Moreover, the same materials – GaN and related compounds – are already used in high power applications as well. When the power density of GaN devices achieved very high values the self heating of devices became a serious technological issue. The talk will show solutions applying diamond and graphene.

Then two-dimensional (2D) nitrides which were grown in the closed space of hydrogenated graphene on SiC will be reported. MOCVD growth was successful and the 2D layers were grown via intercalation. The physical and electronic properties of the most interesting 2D nitride, i.e. InN will be discussed.

Additionally ultrathin MoS_2 layers on wide bandgap semiconductors will be reviewed. This is a new subject, promising partly because the misfit between GaN and MoS_2 is low (<1%) and it is possible to grow single MoS_2 layers which exhibit a direct bandgap. One can learn how we could increase the coverage of substrates keeping the thickness at a monolayer/bilayer level. The grown structures are imaged at the atomic resolution and also analytical results are provided by EDS, EELS and XPS on the ultrathin layers.

The above ultrathin layers had been investigated by aberration corrected transmission electron microscopy and the results will point out how microscopy can support the development of semiconductor devices.