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Epitaxial β-Ga2O3 Thin Films: Why Size Matters

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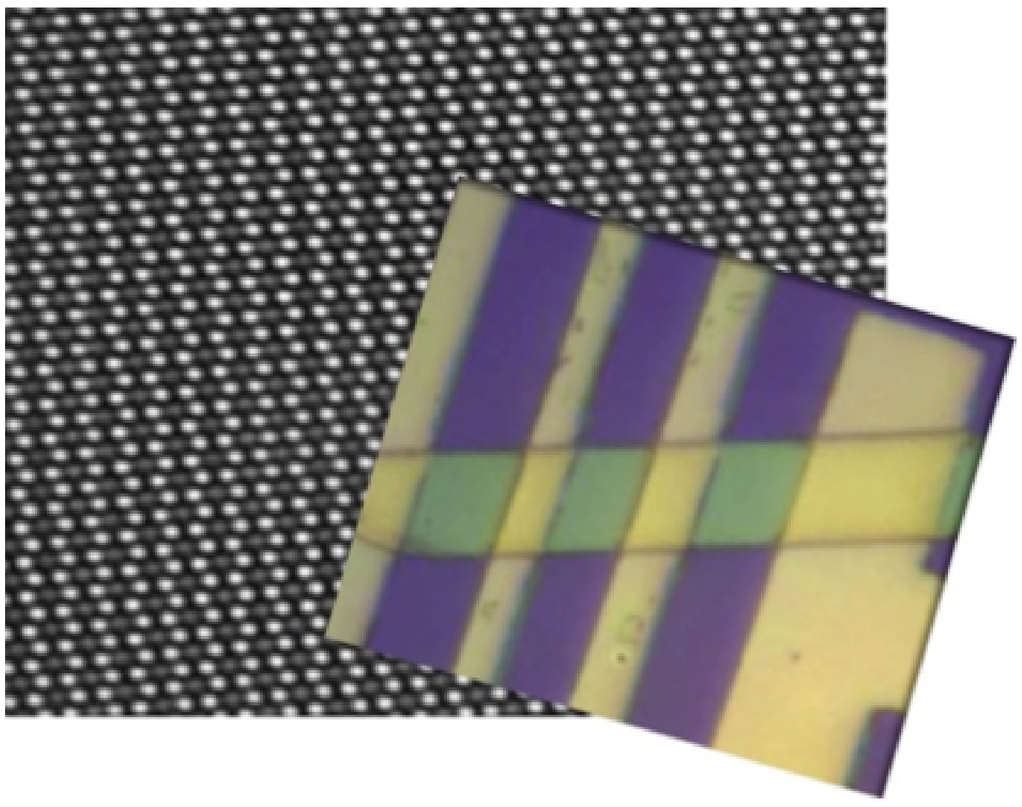
Abstract:

Thin films of the transparent wide-band gap semiconductor β-Ga2O3 have a high potential for applications in future opto- and power electronics. However, the material parameters and the role of interfaces remain to be explored. In this talk, I will give an overview of transport properties in thin films such as the electrical and thermal conductivities, Hall densities, mobilities and thermoelectric properties [1-3] and discuss fundamental limits [4]. In thin homoepitaxially MOVPE grown (100)-orientated β-Ga2O3 films we find that the electron mobilities (115±10 cm2/Vs) in thicker films (>150 nm) are comparable to the best of bulk at room temperature. However, the mobility is strongly reduced by more than two orders of magnitude with decreasing film thickness (5.5±0.5 cm2/Vs for a 28 nm thin film). The commonly applied classical Fuchs-Sondheimer model does not explain sufficiently the contribution of electron scattering at the film surfaces. Instead, by applying an electron wave model by Bergmann, a contribution to the mobility suppression due to the large de Broglie wavelength in β-Ga2O3 is proposed as a limiting quantum mechanical size effect.



References:

[1] Mitdank et al., phys. stat. sol. a 211 (2014) 543. [2] Handwerg et al., SST 31 (2016) 125006. [3] Boy et al., APL Materials 7 (2019) 022526. [4] Ahrling et al., Scientific Reports 9 (2019) 13149.

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