# Materials Science Webinar
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## Integrated Crystal Growth of Advanced Nanomaterials: from model systems to integrated manufacturing

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'Nano' started decades ago as a word of tomorrow. Since then nanoscience has opened a new scale-dependent conceptual understanding of the material world, while nanotechnology has seen many developments in an ever increasing number of sectors, including information & communication technologies, healthcare, energy conversion and storage, security, transport and environmental technologies. This talk will reflect on the journey of my research group in this field, particularly our quest to understand the mechanisms that govern the growth, interfaces and device behaviour of prominent nanomaterials like semiconducting nanowires and 2D mono-layer crystals in realistic process environments. Motivated by the many new device concepts and unique opportunities that these 1D and 2D nanomaterials enable to drive nascent technologies such energy efficient ICT [1,2], we systematically adapt in-operando metrology to explore phase selection and interface dynamics at the nano-scale and to accelerate their development cycles as scalable industrial materials particularly via chemical vapour deposition (CVD). Using in-operando transmission electron microscopy we could reveal the key processes of catalytic group IV and III-V nanowire growth [3], allowing for instance the switching between zinc-blende and wurzite structure with atomic precision [4]. Using in-operando scanning electron microscopy and X-ray photoelectron spectroscopy, we could expand insights from catalytic graphene CVD [5] to nucleation and growth dynamics of compound mono-layer crystals such as h-BN and $WS_2$ [6,7]. The talk will highlight the interdisciplinarity this comprises, ranging from metallurgy and new approaches to epitaxial metal growth [8] to defect characterization by multi-dimensional super-resolution microscopy [9] and machine-learning assisted materials discovery.

[1] Yang et al., Science 365, 1017 (2019).
[2] Pinquemal-Banci et al., Nat Comm. 11, 5670 (2020).
[3] Panciera et al., Nature Materials 14, 820 (2015).
[4] Jacobsson et al. Nature 531, 317 (2016).
[5] Weatherup et al., Nano Lett. 16, 6196 (2016
[6] Wang et al., ACS Nano 13, 2114 (2019)
[7] Fan et al., Nanoscale 12, 22234 (2020)
[8] Burton et al., ACS Nano 14, 13593 (2020)
[9] Stern et al, ACS Nano 13, 4538 (2019)