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Real time electron microscopy of formation of low-dimensional materials

Full understanding of nanostructures' formation is a key for engineering of their physical properties. At nanoscale, this is a very challenging task. Electron microscopy is conventionally used for post-growth analysis of the fabricated nanostructures, and the growers have therefore no choice than perform time-consuming numerous experimental runs with uncertain results. These are often combined with other post-growth techniques, and the growth mechanism is deduced from these correlative experiments. In this regard, real-time in-situ microscopy has become inevitable tool for deducing the growth mechanisms, which is well documented in case of 1D nanostructures (nanowires) using transmission electron microscopy [1]. However, TEM has a very limited usecase due to the requirements posed on the samples. In our work, we have focused on using SEM, and were able to demonstrate several successful experiments dealing with the growth of nanowires (both out-of-plane and in-plane) and, recently, 2D materials. Note that the latter is hardly possible in TEM. We will show different approaches to in-situ electron microscopy, demonstrating the versatility of SEM for this kind of research.

[1] Ross, F. M. Rep. Prog. Phys. 2010, 73, 114501.
[2] Kolibal, M. et al., Nano Letters 2016, 16, 4880.
[3] Kolibal, M. et al., J. Phys. Chem. Lett. 2020, 11, 6498.

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