Interface dynamics of crystalline catalysts during Si nanowire and carbon nanotube CVD

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Self-assembled nanowires and nanotubes offer the prospect of accurate and scalable device engineering at an atomistic scale. However, deterministic nanotube growth and the control of nanowire dopant profiles and heterostructures are limited by an incomplete understanding of the role of commonly used catalysts and specifically their interface dynamics.

Here, we present lattice-resolution, video-rate in-situ transmission electron microscopy studies of the nucleation and growth of Si nanowires for liquid and solid catalyst systems [1]. In both cases, the Si nuclei are initially smaller than the catalyst particles, before expanding and pushing the catalysts onto the tips of the growing wires. For solid catalyst crystals the dominant, coherent nanowire growth interface is observed directly to advance by the lateral propagation of ledges. We propose that interfacial ledge propagation plays a central role in nanowire self-assembly and compare the dynamic catalyst reshaping to graphene nucleation on stepped transition metal films and carbon nanotube formation [2].
