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In-situ TEM observation of epitaxial growth of core/shell GaAs/Ge nanowires

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NANOMAX TEM facility has been developed with the aim of implementing original experiments to study in situ the crystal growth mechanisms of nanoobjects. The growth can be observed in real time at the atomic scale using an environmental electron microscope equipped with an image aberration corrector. The microscope can be implemented either with molecular beam epitaxy (MBE) sources or with a gas injector for chemical vapor deposition (CVD). For this last case, numerous precursors have been installed to enable the growth of various semiconductor heterostructures.

Here we present the growth of GaAs/Ge core/shell structures obtained with CVD. Our goal is to synthesize the hexagonal (2H) crystal phase Ge-2H which may offer a possible direct band-gap optical transition. GaAs nanowires are used as template to epitaxially transfer the wurtzite (W) structure the Ge shell. The GaAs-W and Ge-2H structures take advantage to present almost the same lattice constants.

Au catalyzed GaAs nanowires are grown directly in the microscope at 400°C using TMGa and TBAs precursors. By changing the III/V flux ratio, we manage to monitor the wurtzite/zing-blende polytytpism of the GaAs nanowire. Simultaneously to the shutdown of Ga and As precursors, Ge_2H_6 is injected to start the lateral overgrowth. We show the very first controlled epitaxial growth of Ge-2H on GaAs-W. We discuss the correlation of the formation of intrinsic stacking faults I_3 with the growth modes related to surface diffusion.