Advanced Transmission Electron Microscopy Investigation of Epitaxy-Enabled Morphology Controling ITO Nanowires

O. I. Lebedev [1*], S. Turner[2], Y. Shen[3] , T. Wu[4]

[1] *Laboratoire CRISMAT,UMR 6508, CNRS ENSICAEN, F-14050 Caen, France*
[2] *EMAT, Department of Physics, University of Antwerp, B-2020, Antwerpen, Belgium*
[3] *Division of Physics and Applied Physics, Nanyang Technological University, Singapore 637371*
[4] *Materials Science and Engineering, King Abdullah University of Science and Technology, Thuwal 23955, Saudi Arabia*

Controlling nanowire morphology in bottom-up synthesis and allowing the assembly of nanowires on planar substrates is of tremendous importance for device applications in electronics, photonics, sensing and energy conversion. To date, there has however been only limited success in reliably achieving these goals, hindering both the fundamental understanding of the growth mechanism and the integration of nanowires in real-world technologies. In this work, we will show the impact of advanced TEM(ED, HRTEM, HAADF-STEM and EELS) on this domain, as an extremely versatile and powerful technique.

Novel dual-metal Au-Cu alloy nanoparticles were used as a catalyst for tin-doped indium oxide (ITO) nanowire growth. The enhanced mobility of the catalyst nanoparticles (NPs) enables *in situ* seeded growth of branched ITO nanowires (NWs). The dynamically tuned chemical potentials in the catalyst NPs selectively stabilize a rare cubic indium-tin-oxide phase (ISO), forming epitaxial heterojunctions within individual NW branches. This methodology of selecting phases and forming compositionally abrupt axial heterojunctions in NWs departs from the conventional synthesis routes, giving unprecedented freedom to navigate phase diagrams and promising novel nanomaterials and devices