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Electrical characterization of nanowires combined with in-situ TEM imaging

Sardar Bilal Alam[1], Christopher Røhl Andersen[2, 3, 4, 5], Federico Panciera[6], Ole Hansen[2], Frances M Ross[7, 8], Nika Akopian[3], Kimberly Dick Thelander[4,5], Kristian Mølhave[2]

[1]Materials Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, United States
[2]National Centre for Nano Fabrication and Characterization, Technical University of Denmark, Kgs. Lyngby, Denmark
[3]Department of Photonics Engineering, Technical University of Denmark, Kgs Lyngby, Denmark
[4]Solid State Physics and NanoLund, Lund University, Lund, Sweden
[5]Centre for Analysis and Synthesis, Lund University, Lund, Sweden
[6]C2N, CNRS, Université Paris-Sud-11, Université Paris-Saclay, Palaiseau, France.
[7]IBM T. J. Watson Research Center, Yorktown Heights, NY, United States.
[8]Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA, United States.

Email: Chrisan@dtu.dk

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We have developed unique microfabricated nanowire growth systems that enable epitaxial vapor phase (VPE) nanowire growth on monocrystalline Si cantilever substrates as shown in Fig 1 A). The chip systems enable both direct in-situ TEM observation of growth processes and electrical characterization of nanowires once they have formed bridges between cantilevers[1, 2].

Here we electrically characterize silicon nanowires grown and electrically connected at their two ends in-situ in the TEM at room temperature and elevated temperatures. We observe that the nanowires, which are oxide-free directly after growth, have non-linear current-voltage characteristics, Fig 1 B). We further study the effects of surface modification on the electrical properties of the nanowire by oxidizing the nanowire surface in several stages, recording images at each stage. These observations show how the repeated oxidation decreases the conductivity. Finally, we present new chip designs for characterizing electrical and optical properties of III-V nanowires at the III-V ETEM at Lund University.

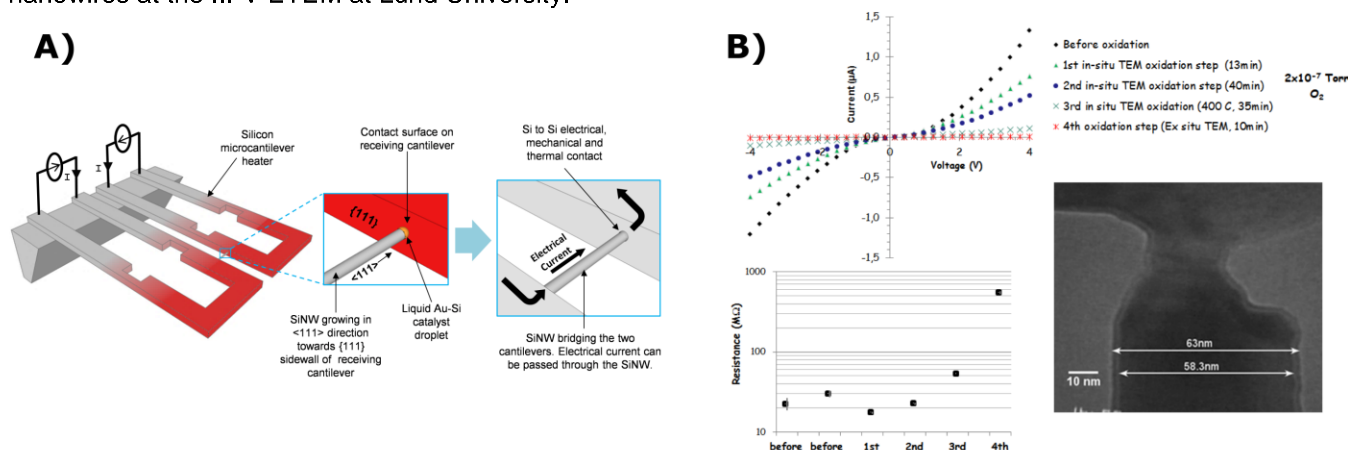

Figure 1. *(A) Schematics of experimental setup used for in-situ growth and electrical characterization of nanowires. (B) IV data and resistance of nanowire shown in TEM image at different surface oxidization steps.*

References

[1] F. Panciera, *et al*, *Nat. Commun.*, vol. 7, (2016), p. 12271.
[2] S. B. Alam, *et al*, *Nano Lett.*, vol. 15, (2015), pp. 6535–6541.
[3] The measurements were performed at IBM T. J. Watson Research Center