Nanowires for tandem junction solar cells.

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Semiconducting nanowires have been recognized as promising materials for high-performance electronics and optics where optical and electrical properties can be tuned individually, where the nanowires due to excellent light absorbing properties [1] have been suggested for future high efficiency solar cells [2, 3]. Especially, the geometrical shape of the nanowires offers excellent light absorption. Using nanowires covering only about 12 % of the surface, record efficiencies of VLS grown nanowires has been reported for InP nanowires of 13.8 % and for GaAs nanowires of 15.3%, and recently 17.8 % efficiency was reported for etched out top down fabricated nanowires.

In order to further optimize the performance of nanowire photovoltaics (PV), and integrate them on Si in a tandem junction configuration, nanowires with dimensions corresponding to optimal light harvesting capability are necessary. We developed nano imprint lithography for patterning of catalytic metal particles with a diameter of 200 nm in a hexagonal pitch of 500 nm, for which synthesis was redeveloped since the metal particles were found to move during annealing, destroying pattern fidelity before nucleation. We found that a pre anneal and nucleation step was necessary to keep the particles in place during high temperature annealing to remove surface oxides. We intend to transfer these grown nanowires to a Si platform (existing PV), either by direct growth on Si PV, or by nanowire peel off in polymer, followed by transfer and electrical contacting, or by aerotaxy and alignment for transfer to Si.

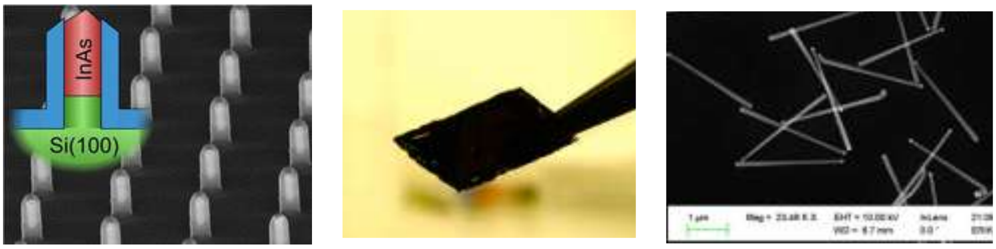

Figure 1) Three approaches for III-V nanowire –Si tandem junction formation. Left: direct growth on Silicon by template assisted selective area growth (IBM) Middle: Nanowire growth, peel off in polymer and transfer to Silicon. (Lund) Right: Aerotaxy, nanowire alignment and transfer to Silicon. (Solvoltaics, Lund)

The optimal band gap in combination with Silicon is about 1.7 eV, where we identify GaInP and GaAsP as materials for development of nanowire pn junctions by doping, the heart in a solar cell.

1. J. Wallentin et al. *Science*, **339**, 1057 (2013)
2. N. Anttu et al., *Phys. Rev. B* **83**, 165431 (2011)
3. J. Kupec et al., *Opt. Express* **18**, 27589 (2010)
4. Åberg et al, IEEE J. of Photov, **6**, 185 (2016)

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