On the path towards tandem junction nanowire based 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 individual. Especially, nanowires have been identified as a means to high efficiency solar cells [1, 2] using significantly reduced materials consumption due to strong geometrically enhanced light absorbing properties [3].
In order to further optimize the performance of NWPV, 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. 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. We used electron beam induced current measurements as a tool to optimize the electrostatic potential profile in nanowires, leading to 15 % efficient InP nanowire solar cells, even though only covering about 10 % of the substrate surface. The optimal band gap in combination with Si is about 1.7 eV, where we identify GaInP and GaAsP as materials for development of nanowire *pn* junctions, the heart in a solar cell.

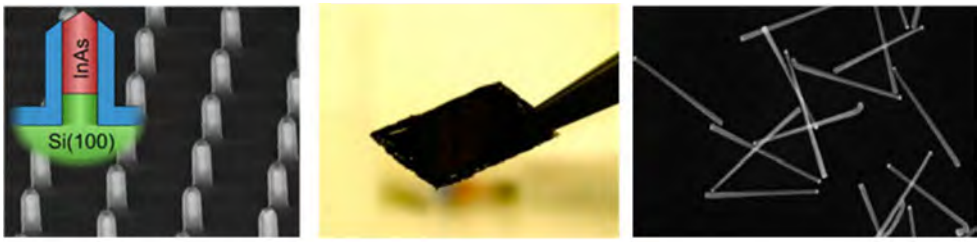

Figure 1 Simple sketch of the three different approaches. Left- template-assisted epitaxy, TASE, middle- SEM image of epitaxially grown nanowires, peeled off and held with a tweezer, intended for transfer to a Si cell. The membrane is black due to efficient light absorption in the nanowire membrane. Right- substrate-free growth by Aerotaxy, alignment and contacting

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2. J. Kupec et al., Opt. Express **18**, 27589 (2010)
3. J. Wallentin et al. Science, **339**, 1057 (2013)
4. Åberg et al, IEEE J. of Photov, **6**, 185 (2016)

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