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Next Generation III-V Nanowire-based Heterostructure Solar Cells and Photodetectors Integrated on Silicon

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III-V based nanowire (NW) heterostructures are one of the most promising candidates for future opto-electronic devices like light emitters and detectors, particularly when integrated onto the well-developed Silicon (Si) platform. Using nano-imprint lithography (NIL) to prepattern Si (111) wafer, NW arrays with very high growth yield (>90%) can be achieved over large–scale areas. Developing a state of the art UV-imprint process we could significantly enhance the flexibility of the NIL setup using a novel home-designed table top device. By producing replicas of NIL stamps with various patterns, full control over the inter-NW spacing could be achieved, one crucial prerequisite to further increase the efficiency of NW-based solar cells fabricated from InGaAs-InAlAs NW heterostructures. Using these optimized prepatterned substrates, NW growth is performed in a completely catalyst-free growth regime via molecular beam epitaxy, allowing detailed insight into morphology (scanning electron microscopy, SEM), luminescence properties (micro-luminescence, μ-PL) and absorption cross-section (Fourier transform infrared spectroscopy, FTIR) for different interwire-spacings. This opens numerous opportunities to advance NW-based heterostructures, such as integrated nanophotonic sources on Si and NW-based photovoltaics.

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