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High-throughput Approaches for Engineering Nanodevices

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Abstract **–** Nanoscale semiconductor materials, such as III–V nanowires, possess unique properties that can be exploited to achieve novel device functionalities. Examples of such devices include polarisation-sensitive terahertz-band nanowire devices [1] and nanowire photoresponsive memory devices [2]. However, the nanoscale size of these structures also poses challenges for nanomaterial characterisation and integration into devices. In addition, the processing of such nanodevices is laborious and the yield is typically low. Higher-throughput and scalable approaches are needed to address these challenges.

To address this problem, we are developing high-throughput approaches that expedite nanomaterials characterisation, nanodevice processing, and nanodevice integration. For example, using a quantum multiplexer, we have addressed arrays of transfer-printed single InAs nanowires from room temperature down to 4.2 K [3].

One solution is the automation of characterisation, device design and fabrication. By combining automated microscopy and machine vision with lithographically compatible alignment markers, we have automated the process of identifying and locating individual nanowires within a randomly positioned distribution. An automated process of electrode design then allows the rapid fabrication of hundreds of single-nanowire devices [4]. These automated methods also enable cross-correlation down to the single-nanowire level between complementary characterisation techniques such as electrical measurements, photoluminescence spectroscopy [5], cathodoluminescence spectroscopy [6] and terahertz conductivity spectroscopy [7].

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