Semiconductor Nanowire THz Photonics

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We have developed modulators and detectors of terahertz (THz) frequency radiation by exploiting the unique properties of semiconductor nanowires. Our new cross-nanowire THz receiver is enabling the emerging field of THz polarimetry.

The geometry and unique electrical properties of quasi one-dimensional semiconductors makes these materials ideal for new applications in very high-frequency electronics [1]. In particular, the low capacitance and high electron mobility of single-crystal III-V semiconductor nanowires creates the ideal building blocks of devices for terahertz (THz) frequency electronics [1,2]. It is currently critical to develop components for terahertz electronics, such as receivers and modulators, to form a technological foundation for future 6G telecommunications.

We have recently demonstrated a series of practical applications for III-V nanowires in THz devices that exploit the unique properties of semiconductor nanowires. We have developed sensors for THz radiation that operate at room temperature and provide simultaneous polarisation and phase information [3]. Our detectors are fabricated from InP nanowires individually positioned into a suspended hash structure (see figure 1). The polarisation purity and crosstalk suppression of these nanowire devices exceeds that of any other monolithic THz detector technology to date. The compact size of these hash devices also makes them promising for extended applications in nano-imaging systems and for applications in THz polarimetry [4].

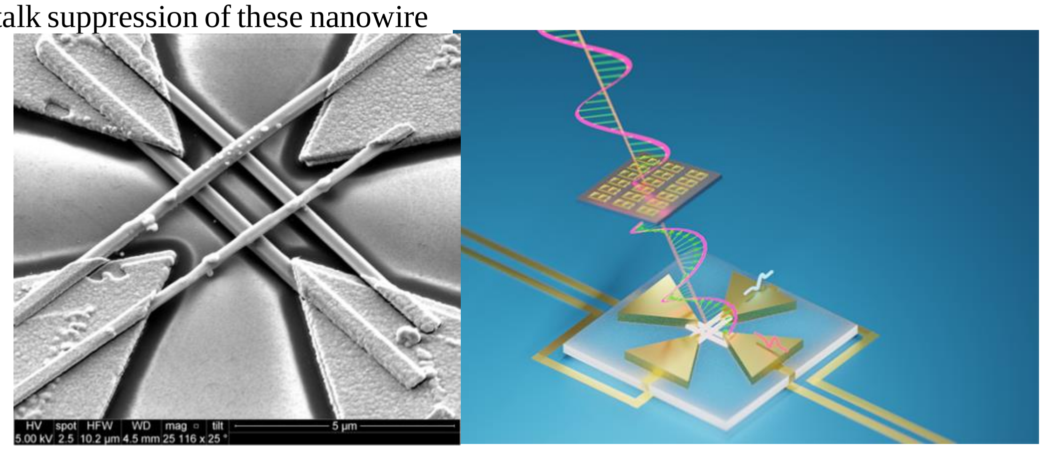

Figure 1 (left) SEM image of a forest of cross nanowire THz detector [3]. The scale bar is 5 micron. (right) Artist's impression of the hash nanowire detector in operation (image credit: SEM: M. Rothmann, Rendering: D. Jevtics)

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