Self-assembled InAs quantum dots for FIR/THz devices

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In the past few years, we have witnessed impressive advances in the growth of self-assembled InAs quantum dots (QD) on GaAs substrates. These QDs have resulted in lasers working in the near infrared spectrum, with excellent performance. QD lasers rely on (conduction-to-valence) *interband* transitions similar to a conventional quantum well (QW) laser. The important difference is that QD laser involves transitions between discrete atomic-like levels while QW laser uses transitions between two-dimensional subbands.

Another class of devices can be envisioned involves *intraband* transitions. Analogous to the well-developed quantum well infrared photodetector (QWIP) and quantum cascade laser (QCL), one can imagine detectors and emitters relying on transitions between QD levels within the conduction band. Given the QD level separations currently achieved within the range of 1–100 meV, the wavelength/frequency covered by these devices naturally fall into the far-infrared (FIR) and terahertz (THz) region.

This presentation starts with what has already been demonstrated, the quantum dot infrared photodetector (QDIP). Experimental results on a variety of samples are shown. Performance issues, especially comparing QWIP and QDIP, are discussed. We then turn to the more exciting direction of realizing a FIR/THz laser using QDs.