Type-II Superlattice HOT Infrared Photodetectors

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Recently, a new strategy to achieve high-operating temperature (HOT) infrared photodetectors including barrier and cascade devices has been observed. Another method to reduce dark current is related to the limitation of the volume of detector material via a concept of a photon-trapping detector.

The paper presents approaches, materials, and device structures of the new types of infrared detectors. The intent is to concentrate on device approaches that are having the most impact today in the main stream of infrared detector technologies. A secondary aim is to outline the evolution of detector technologies showing why certain device designs and architecture have emerged as more useful today also as alternative technologies competitive to HgCdTe ternary alloy.

The performance of an innovative HOT detector designing so-called interband (IB) cascade type-II InAs/GaSb superlattice detectors is presented. Detailed analysis of the detector's performance (such as dark current, RA product, current responsivity, and response time) versus bias voltage and operating temperatures (220 to 400 K) is performed, pointing out the optimal working conditions.

The performance of nBn detector and cascade detector is compared with HgCdTe HOT detectors. At the present stage of technology, the experimentally measured R_0A values of the IB cascade type-II superlattice detectors at room temperature are higher than those predicted for HgCdTe photodiodes. It is shown that these HOT detectors have emerged as the competitors of HgCdTe photodetectors.