Far-Infrared Floating Gate Photoconductors

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Keywords: far infrared, quantum wells, photoconductors

Background and Significance We have demonstrated two different mechanisms of far-infrared detection in GaAs/AlGaAs double-quantum wells operating as floating gate photoconductors. Current modulation is effected by intersubband absorption followed by electron transfer to an adjacent quantum well or to DX centres, leading to responsivities of 100 A/W and 500 A/J, and operating temperatures of up to 30K and 100K, respectively. High gains are achieved by the direct incorporation of transistor gain within the floating gate architecture. The ultimate goal of this work is to develop a high-responsivity, high-detectivity far-infrared detector compatible with use as a pixel in focal plane arrays for imaging applications.

Methodology: We have fabricated and tested a GaAs/AlGaAs double quantum well heterostructure based on a floating gate architecture, using photolithography, electron beam lithography and other standard fabrication techniques. The MBE grown material was supplied by IQEP Inc. (Bethlehem, Pennsylvania). In the first mechanism (M1), the photosensitive quantum well is electrically isolated to act as a floating gate atop a second adjacent quantum well that acts as a high electron mobility transistor (HEMT) channel. In the second mechanism (M2), the photosensitive quantum well acts as a transistor channel. Photoexcited electrons tunnel into a Si δ-doped area, whose primary function is to supply the quantum well with electrons, but which also acts as a floating gate. Photoconductance measurements were taken in a 10K optical cryostat with a 1000K globar source filtered by an IR monochromator.

Collaborators – NA

Selected publications


Acknowledgement: NSERC, FQRNT, Canada Research Chairs Program

Figure 1: (a) Double quantum-well floating gate photoconductor in GaAs/AlGaAs material system. Mechanisms M1 (b) and M2 (c), including measured photoresponse curves at different operating temperatures in response to thermal IR in the 12-20µm wavelength range.

Project duration: Sep 2009 – Dec 2010