Germanium Infrared Absorption Chopper

Professor Harvey Rutt, Mr Peter Fairley

University of Southampton, Department of Electronics and Computer Science,
Highfield, Southampton SO9 5NH
Tel: 0703 593814, Fax: 0703 593835, E-mail: h.rutt@uk.ac.soton.ecs

The use of Pyroelectric array detectors in Infrared cameras in the 8 to 14 μm region necessitates a means for area-modulation, or 'chopping' of the infrared scene, thus generating an element of change for measurement by the detector. Currently this is achieved by mechanically 'chopping' the image using a rotating blade, with drawbacks of high electric motor power, 'blurring' as camera motion changes the rotational speed, and the chopper blade largely determining the camera diameter.

Adequate modulation using a novel method has been achieved in the 8 to 14 μm region by introducing moderate levels of excess carriers to suitably prepared Germanium. These were introduced via excitation from a diode laser source.

The process described uses inter valence band trasitions from the light-hole to heavy-hole band, requiring power densitities in the order of Watts cm^{-2}. Modulation of from 44% to 6% transmission at 10μm using a power density of 28.6 W cm^{-2} from an A1GaAs 809nm laser is easily achievable. The 'on' state transmission will then be then increased to essentially 100% by using anti-reflection coatings. We will describe the relative importance of the bulk and surface properties; high bulk purity and low surface recombination velocities being required to make an effective device, although operation is possible with lower quality material. The most suitable material for the device is low carrier density n-Germanium.

The modulator does <u>not</u> operate in the much-publicised intra-band transition region which involves generating a free carrier density greater than the critical density, typically requiring laser powers in the order of MW cm^{-2}.