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Terahertz Frequency Imaging Systems for Biomedical & other Applications
TERAVISION IST-1999-10154

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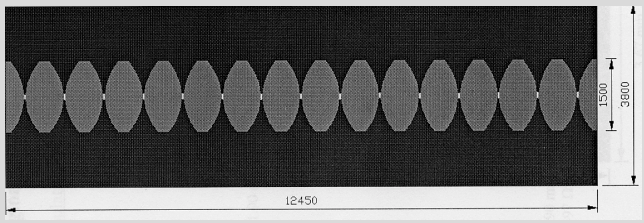
PROJECT DESCRIPTION

Compact terahertz (THz) pulsed imaging (TPI) systems will be realized using short (fs) near infra red (NIR) pulses which impinge on semiconductor (and other) "photoconverters". NIR lasers will be developed with average power exceeding 2W, and an overall footprint less than 50cm x 70cm. Photoconverter efficiencies will be increased by at least 100X over present levels. Developments in detector and image acquisition techniques will enhance signal: noise by at least 10X. A complete, compact, TPI system will be constructed with an average output power of at least 200-300 microwatt. This will deliver images of samples up to 5cm x 5cm, at a rate of 2-3 per minute, containing information from 1-10THz. The final system will encompass developments necessary to enhance its use in medical work. To achieve this, systematic investigation of the use of TPI systems in medicine will be made, involving comparisons with other imaging technologies; new imaging software will be developed. THz imaging, using the mixing of cwNIR lasers, will also be investigated. A compact CW imaging system will be realised. Imaging at 1THz will be demonstrated and comparisons made with TPI system performance.

OUR ROLE IN THE PROJECT

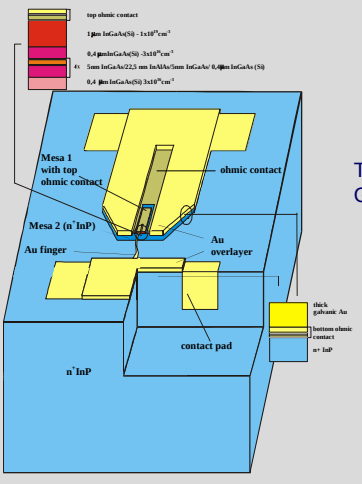
to develop the electronic system for THz application based on heterostructure barrier varactors (HBV) technology, containing a non-linear transmission line (NLTL), mounted in a micromachined waveguide section.



15 NLTL Sections loaded with HBV diode

RESULTS

The HBV diode is a unipolar device, which makes use of an heterostructure potential barrier controlling conduction through the device. In the simplest system an undoped high bandgap material ("barrier") is sandwiched between two moderately doped n-type low bandgap materials ("depletion"). When the diode is biased, a depletion region builds which results in a non-linear CV dependence. The main advantage of this device is the possibility to epitaxially stack several barriers, which increases the power capability and the device area for certain operation frequency. In addition, highly doped capping and buried layers are grown for implementing low-resistance ohmic contacts. Final device structure is usually fabricated as a mesa structure with two ohmic contacts.



Basic HBV diode structure

The key processing steps for the fabrication of GaInAs/AlInAs/InP HBV diode have been developed:

- Formation of ohmic contacts
- Deep anisotropic etching of small areas
- Fabrication of deep large area mesas and "vias" in InP
- Formation of an air bridge fine-finger structure
- Thick-film metallization of "vias' and contact pads
- Top-side encapsulation of HBVs structures
- Top surface bonding of HBV structures to glass substrate
- Backside thinning of HBV structures

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