PHOTORESPONSE OF SI:B BLOCKED-IMPURITY-BAND STRUCTURE IN A MAGNETIC FIELD

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Ge- and Si-based photoconductors are widely used in highly sensitive IR and FIR detectors approaching background limited noise performance. However, they are also quite sensitive to magnetic fields, which limit their use in high field IR magneto-spectroscopy. Recently, it has been demonstrated that photocurrent in Si:B structures with blocked hopping conductivity in the impurity band (blocked-impurity-band or BIB structures) turns out to be poorly sensitive to a magnetic field [1]. Si:B BIB structures have been also used to study impurity photoconductivity mechanisms under high electric fields [2]. The measurements reported here were intended to investigate the magnetic field effect on the spectral photoresponse in Si:B BIB structures and to check their suitability for direct use in magnetic fields.

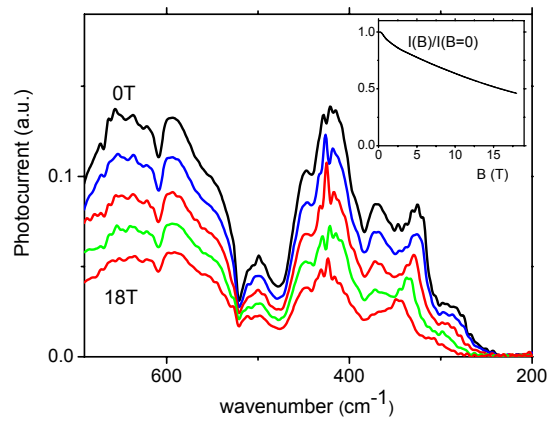

Fig. 1. Spectral response of Si:B BIB for B=0, 3 T, 7.5 T, 12 T and 18T measured at 7.2K and under direct voltage bias of 0.9V. The spectra are not normalized to the instrument spectral function. The inset shows the magnetic field dependence of BIB photocurrent measured at high radiation background.

The structure investigated is constructed of adjacent layers of both pure and boron doped ($N_a \approx 10^{18}$ cm^{-3}) silicon inserted between highly doped ohmic contact layers. The Si:B BIB detector was measured with a standard FIR probe and the Bruker113 FTIR spectrometer in magnetic fields up to 18T. Fig.1 shows photocurrent spectra measured under direct voltage bias for several values of magnetic field. At B=0, the BIB structure exhibits a broadband response from 2500 cm^{-1} to 250 cm^{-1} (4 μm -40 μm). In an applied magnetic field, the photocurrent spectra decrease gradually in intensity and display a blueshift of the low-energy cutoff. At 18T, the Si:B BIB remains very sensitive to the IR radiation above 285 cm^{-1} (35 μm). High-resolution spectra taken at both direct and reverse biases allow us to follow a magnetic field dependence of narrow peaks associated with optical excitations of boron impurities. We have also performed measurements of photovoltaic effect in order to complete the data taken in pulsed magnetic fields at the LNCMP.

These experiments have provided important data for the better understanding of hopping conductivity and photoexcitation mechanisms in the BIB systems. Further analysis is underway.

References

[1] O.Drachenko, PhD thesis (2004).
[2] S.Pasquier,C.Meny, L.Asadauskas, J.Leotin, B.A.Aronzon, V.V.Rylkov, V.Conedera, N.Fabre, S.Regolini, C.Morin, J. Appl. Phys., **83**, 4222-4229 (1998).