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The nature of terahertz emission from GaAsBi

Abstract: Under ultrafast near-infrared optical excitation many semiconductors emit electromagnetic radiation at terahertz (THz) frequencies. The two principal physical mechanisms involved are transient currents and optical rectification. Detailed studies have been made of the THz emission from GaBiAs epitaxial layers grown on both (001) and (311)B GaAs substrates [1]. The principal experimental observations are: (a) (001) epilayers emit negligibly, (311)B layers emit strongly; (b) THz emission from GaBiAs epilayers varies linearly with pump laser power; (c) THz emission from GaBiAs epilayers is independent of an applied in-plane magnetic field; (d) THz emission from GaBiAs epilayers shows three maxima and three minima as the azimuthal angle is varied through one complete rotation, in contrast to the emission from the GaAs substrate, which exhibits a single maximum and a single minimum; (e) THz emission from GaBiAs is significantly greater than THz emission from the GaAs substrate. These data taken together indicate that transient currents play a negligible role and the emission is dominated by optical rectification. Moreover, the mechanism is not bulk optical rectification alone. The additional contribution of a surface electric field in accord with recent theory [2] accounts for the observations.

[1] K. Radhanpura, S. Hargreaves, R. A. Lewis, and M. Henini, "The role of optical rectification in the generation of terahertz radiation from GaBiAs", Applied Physics Letters 94, 251115 (2009). [3 pages]
[2] S. Hargreaves, K. Radhanpura, R. A. Lewis, "Generation of terahertz radiation by bulk and surface optical rectification from crystal planes of arbitrary orientation" Physical Review B 80, 195323 (2009). [16 pages]