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GaAs Refractive Index Dependence On Carrier Density and Optimizing Terahertz Devices CHRISTOPHER KIM, DONG HO WU, BENJAMIN GRABER, US Naval Research Laboratory — GaAs is used for various applications, including high speed transistors, high-efficiency photovoltaic cells, electro-optics and terahertz (THz) emitters and detectors. To date, information on the refractive index of GaAs is available only over a limited wave spectrum of 0.2-17um, where the refractive index varies from 1.3 to 5.0. As detailed information on the refractive index of GaAs at THz frequencies is not available or inadequate for our effort to develop an improved GaAs-based THz emitter, we experimentally investigated the behavior of the refractive index of GaAs for different charge carrier densities, especially with or without the presence of surface plasma. Using a Time Domain THz Spectrometer, which is capable of measuring THz pulses containing a wave spectrum over 100-3000um with a time accuracy better than 6 femtoseconds, we measured the delay of THz pulses traversing through a GaAs substrate of known thickness while modulating the charge carrier concentration. From the experimental data we estimated the refractive index for THz frequencies to vary from 3.5 to 3.8 for different charge carrier concentrations. We will discuss details of our experiments and implications of our experimental results, especially for our GaAs-based THz devices.

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