Terahertz Wave Detection in Metal-GaAs-Metal Structures using Cherenkov-phase-matched Electro-optic Sampling

°**Ramon delos Santos[1, 2], Valynn Mag-usara[3], Syougo Azuma[3], Armando Somintac[1], Arnel Salvador[1], Elmer Estacio[1], Kohji Yamamoto[3], Masahiko Tani[3]**

[1]Condensed Matter Physics Laboratory, National Institute of Physics, University of the Philippines, Diliman, Quezon City, Philippines
[2]Department of Physics, Ateneo de Manila University, Quezon City, Philippines
[3]Research Center for Development of Far-Infrared Region, University of Fukui, Fukui, Japan

°**E-mail: rdelossantos@nip.upd.edu.ph**

The possibility of new and more exciting terahertz (THz) technology impels the development of sensitive but simple detectors. Electro-optic (EO) detection scheme is a viable choice because it does not require micro-fabrication facilities unlike photoconductive antenna and it has been shown to be sensitive to high frequencies by using materials with large electro-optic coefficients. Cherenkov-phase-matched EO detection in GaAs is possible at 1.55 μm optical sampling wavelength because the crystal's group refractive index, n_g, at 1.55 μm is less than its THz refractive index, n_{THz}, at 1 THz [1]. In this study, we performed THz wave detection measurements in Cherenkov-phase-matched EO sampling at 1.55 μm by using metal-GaAs-metal samples inserted into a thin metallic parallel-plate waveguide (PPWG). GaAs (100) with aluminum film on its four facets, except on the <0, -1, -1> planes, were used as detectors in a THz time-domain spectroscopy (THz-TDS) system. A spiral antenna was utilized as an emitter, pumped by the 2nd harmonic of the 1.55 μm fs fiber laser. Results indicate that the peak-to-peak EO signal from bare GaAs reference sample was less than that from the metal-GaAs-metal samples. Regardless of the sample thickness, spectral bandwidth of the detected THz signal from metal-GaAs-metal structures was roughly at 1.75 THz while that of the reference sample is at 1.25 THz. The signal-to-noise ratio (SNR) on all samples was 4 orders of magnitude.

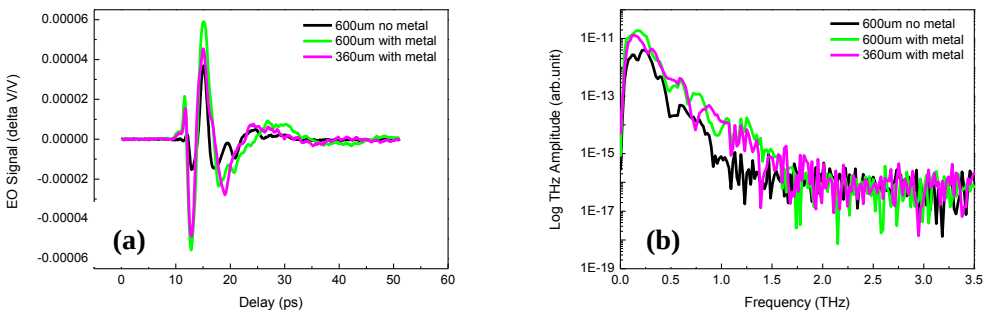

Figure 1: (a) EO signal from bare GaAs reference sample and two metal-GaAs-metal structures. (b) The corresponding logarithmic THz intensity of the detected signal.

Reference:
1. S. Ozawa, *et al.*, Proceedings of the 38th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz 2013, Mainz, September 1-6, 2013), We P2-51.