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Control of polarization ellipticity of THz radiation with ultrathin metamaterial.

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THz radiation has got growing importance for industry last decades because of useful combination of properties especially for biomedical diagnostics and nondestructive testing. Additional data can be extracted from THz imaging due to polarization state of THz beam [1]. Polarization spectroscopy make new demands to optical components of THz setups. In additional to lens and mirrors, THz setup should include components for polarization control which still remains challenging. Ordinary, THz polarization metamaterials work similarly to visible range components where birefringence is provided which helps them to achieve high efficiency.

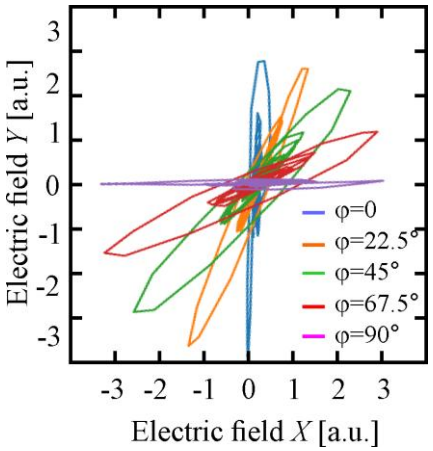

Fig. 1 Polarization state evolution of the radiation passed through a sample.

However, since wavelength of THz radiation starts from 30 μm, for THz range typical metamaterials have requirement to be hundreds of micrometers in thickness to be able change polarization state effectively. It limits their application and fabrication issues to be resolved appears. That is why industry is interested in development ultrathin structures providing polarization control in THz range.

In this work we demonstrate polarization conversion of THz radiation in a broad spectral range. For the demonstration we fabricated THz metamaterial stripe samples with different parameters made of carbon nanotube (CNT) film (100 nm thickness) applied to silicon substrate. For experiments we used time domain spectrometer using electrooptic sampling with polarization modulation of probe pulses which allows highly precise and accurate terahertz polarization measurements [2]. We analyzed the polarization state of THz waves passed through the samples and observed transformation of linearly polarized THz wave into elliptically polarized one at different angles φ between plane of polarization and CNT stripes. Fig. 1 shows polarization state evolution of the radiation passed through a sample demonstrating changing of ellipticity of polarization depending on φ. The results open way for developing of ultrathin THz devices for polarization control in THz spectrometry and THz imaging.

REFERENCES

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