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Improving Spatial Resolution of Real-Time Terahertz Near-Field Microscope

Source

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Abstract

Terahertz (THz) wave imaging for biomaterial samples such as cells requires real-time acquisition and high spatial resolution beyond the diffraction limit. The existing THz near-field microscopes are based on raster-scanning techniques, and are therefore not able to image and trace morphological changes in a large area. With the recent advances in high-power THz sources, we demonstrated how to achieve high spatial resolution over a large size using a conventional charge-coupled-device (CCD) camera with the electro-optic (EO) sampling technique. In this paper, we determine a limiting factor that restricts spatial resolution in our near-field microscope. By calculating the imaging performance of the probe beam together with THz wave diffraction, we show that the most relevant factor is the diffraction inside the EO crystal. Near-field imaging of metal patterns using EO crystals with different thicknesses supports this calculation. A thin EO crystal is essential for achieving THz images with high spatial resolution.