FIU Engineering & Computing
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Electrical & Computer Engineering

MULTI-ELEMENT PLASMONIC DEVICES FOR TUNABLE THZ DETECTION APPLICATIONS

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Abstract: Terahertz technologies utilize electromagnetic radiation in the frequency range between 300 GHz and 10 THz. Potential applications for terahertz technology in biology, chemistry, medicine, astronomy and security are wide ranging. THz radiation can penetrate non-metallic materials such as fabric, leather, plastic which makes it useful in security screening for concealed weapons. The THz frequencies correspond to energy levels of molecular rotations and vibrations of DNA and proteins, as well as explosives, and these may provide characteristic fingerprints to differentiate biological tissues in a region of the spectrum not previously explored for medical use or detect and identify trace amount of explosives. Most of the existing and envisioned THz applications require frequency selectivity. Frequency selectivity can be attained either on the source side by employing tunable sources or on the detector side. Today the most sensitive THz detectors such as Golay cells, pyroelectric detectors, bolometers and Schottky diodes are either not portable or very slow and definitely not tunable.

New ideas of using plasmonic resonances in the two-dimensional electron gas for tunable emission and detection of terahertz radiation are being explored and proven experimentally culminating in the recent demonstration of resonant detection of the THz radiation at room temperature. The theory predicts that such detectors should have very high sensitivities. The plasmonic detectors are capable for operating even at zero bias current, thus minimizing shot noise and allowing unprecedented sensitivity. Most intriguing advantage of all, the plasmonic terahertz detectors are tunable by DC bias over a wide frequency range. These detectors can detect not only the intensity but also polarization and direction of a terahertz beam. We present the basic principles of plasmonic THz devices as well as our recent work.

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