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Plasmonics-enhanced photoconductive terahertz optoelectronics

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We present new designs of photoconductive terahertz sources and detectors that utilize plasmonic electrodes to offer significantly higher terahertz radiation powers and detection sensitivities compared to the state-of-the-art. The use of plasmonic contact electrodes in a photoconductive terahertz source and detector manipulates the spatial distribution of photocarriers and enhances the number of photocarriers in nanoscale distances from contact electrodes significantly, enabling efficient collection of the majority of carriers in a sub-picosecond time scale. It also allows increasing photoconductor active area without a considerable impact on device parasitics, boosting the maximum terahertz radiation power and detection sensitivity by preventing the carrier screening effect and thermal breakdown at high optical pump powers. We experimentally demonstrate two-orders of magnitude higher terahertz powers and one-order of magnitude higher terahertz detection sensitivities from our first generation plasmonic photoconductive sources and detectors in comparison with similar conventional photoconductive terahertz sources and detectors with non-plasmonic contact electrodes. As a result, the use our first generation plasmonic photoconductive terahertz sources and detectors in a terahertz spectroscopy system offers more than three-orders of magnitude higher signal-to-noise ratio levels compared to conventional terahertz spectroscopy systems.

Biography

Mona Jarrahi received her Ph.D. degree in Electrical Engineering from Stanford University (2007) and served as a postdoctoral scholar at Berkeley Sensor and Actuator Center (2007-2008). She joined University of Michigan in the fall of 2008, where she is currently an Assistant Professor of Electrical Engineering, leading the Terahertz Electronics Laboratory. Her research group focuses on terahertz/millimeter-wave electronics and optoelectronics, imaging and spectroscopy systems, as well as microwave photonics and ultrafast electro-optics.

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