Demonstration and Characterization of Split Ring Resonators as Terahertz Waveguides

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In order to meet the demands of computing and communication, new approaches are needed to increase data operating speeds to terahertz (THz) and higher frequencies. Guided wave devices afford a simple and compact means for harvesting the potential of the photon, the ultimate unit of information, packaging data in a signal of zero mass that has unmatched speed. Although, the overall goal of terahertz waveguides is to find a geometry with the lowest loss, traditionally terahertz waveguides have high loss and loosely confined waves as most materials, such as dielectric, exhibit high loss. Therefore, I propose to use split ring resonators (SSRs) as an effective medium for terahertz waveguides, with a tight confinement of terahertz radiation and the possibility to form a negative index of refraction (NIR). Both simulations and experimental work were performed for this study. The numerical simulations were performed using XFDTD 6.3 (Remcom Inc.), while the experimental work was performed using an ultrafast laser-based THz time-domain spectrometer. This study demonstrated the possibility to use SRRs as terahertz waveguides, which were created using 3D printing and sputter depositing 500nm of gold on the surface of the structure. Using 3D printing for waveguide fabrication is advantageous to other techniques as 3D printing is less complex. The results indicate that the waveguide has a tight lateral and vertical confinement and a long propagation length. A longer propagation length allows the possible fabrication of THz circuits. It also demonstrated and characterized the possible presence of a NIR. The formation of a NIR would allow the development not only for more complex optical circuits, but also a superlens, a cloaking field, and have applications in biological imaging.

Awards Won:
Third Award of $1,000