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Nonlinear metamaterials through enhanced impact ionization in GaAs at terahertz frequencies KEBIN FAN, Boston Univeristy, HAROLD HWANG, Massachusetts Institute of Technology, MENGKUN LIU, ANDREW STRIKWERDA, JINGDI ZHANG, AARON STERNBACH, XIN ZHANG, Boston Univeristy, KEITH NELSON, Massachusetts Institute of Technology, RICHARD AVERITT, Boston Univeristy, BOSTON UNIVERISTY TEAM, MASSACHUSETTS INSTITUTE OF TECHNOLOGY TEAM — We report the experimental observation of a nonlinear response in metamaterial split ring resonators on semi-insulating GaAs at terahertz frequencies. Using metamaterials with narrow gaps (down to 1μm), a local in-gap THz field of 3.5 MV/cm was achieved with a field enhancement of $\sim$20 on resonance. With increasing THz electric field the metamaterial resonance is gradually quenched as the capacitive gap is shorted due to a large change in the local conductivity in the gap. This indicates an increase of the local carrier density by ten orders of magnitude resulting from impact ionization. Hybrid metamaterials with intense local electric fields not only have the potential to serve as a new tool to study nonequilibrium transport phenomena in materials, but also provide a new way to explore nonlinear metamaterials at terahertz frequencies.

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