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Tunable Terahertz Metamaterials

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In recent years terahertz (1 THz = 10^{12} Hz) technology has become an optimistic candidate for numerous sensing, imaging, and diagnostic applications. Nevertheless, THz technology still suffers from a deficiency in high-power sources, efficient detectors, and other functional devices ubiquitous in neighboring microwave and infrared frequency bands, such as amplifiers, modulators, and switches. One of the greatest obstacles in this progress is the lack of materials that naturally respond well to THz radiation. The potential of metamaterials for THz applications originates from their resonant electromagnetic response, which significantly enhances their interaction with THz radiation. Thus, metamaterials offer a route towards helping to fill the so-called "THz gap." In this work we present a series of novel planar THz metamaterials. Importantly, the critical dependence of the resonant response on the supporting substrate and/or the fabricated structure enables the creation of active THz metamaterial devices. We show that the resonant response can be controlled using optical or electrical approaches, enabling efficient THz switches and modulators which will be of importance for advancing numerous real world THz applications.