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Active Terahertz Metamaterials

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In recent years terahertz (THz) technology has become an optimistic candidate for numerous sensing, imaging, and diagnostic applications. Yet, THz technology still suffers from a deficiency in sources, detectors, modulators and other functional elements ubiquitous in neighboring microwave and infrared frequency bands. 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".

Here, we present a series of novel THz metamaterials with designed active functionality, enabling dynamic tuning of the amplitude, frequency and polarization state of a THz wave. In these materials 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 excitation and thermal tuning, enabling efficient THz devices which will be of importance for advancing numerous real-world THz applications.

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