

## A Terahertz Sensor and Dynamic Switch Based on a Bilayer Toroidal Metamaterial

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**Abstract :** Toroidal resonances, a new class of electromagnetic excitations, demonstrate exceptional properties as compared to electric and magnetic dipolar resonances. The advantage of narrow linewidth in toroidal resonance is utilized in this proposed work, where a bilayer metamaterial (MM) sensor has been designed in the terahertz frequency regime (THz). A toroidal MM geometry in a single layer is first studied. A second identical MM geometry placed on top of the first layer results in the coupling of toroidal excitations, leading to an increase in the quality factor (Q) of the resonance. The sensing capability of the resonance is studied. Further, the dynamic switching from an 'off' stage to an 'on' stage in the bilayer configuration is explored. The ardent study of such toroidal bilayer MMs could provide significant potential in the development of bio-molecular and chemical sensors, switches, and modulators.

**Keywords :** toroidal resonance, bilayer, metamaterial, terahertz, sensing, switching

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