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Nanowire Based Closed Ring Resonators with Extremely High Quality Factors

Ultra-high Q-Factor

A new type of terahertz (THz) metamaterial (MM), closed ring resonator (CRR) boasts an extremely high quality factor (Q-factor). The CRR contains thousands of metallic nanowires with nanometer sized dielectric gaps between them, and the displacement current between the nanowires drives the CRR working at its electromagnetic resonant frequencies. Dielectric nanogaps are added to the CRRs and the surface area forming the resonator significantly increases. This dramatically increases the amount of stored electrical energy in an electrical field while dramatically reducing the ohmic losses of the nanowire-based CRR, leading to ultra-high Q-factors (the Q-factor is expected to be larger than 11000, more than 1000 times higher than that of conventional film-based resonators). This new nanowire-based CRR is an ideal candidate for biomaterial and chemical sensing.

Enhanced Q-factor and Sensitivity

Conventional thin film MMs suffer from low Q-factor and low sensitivity, which limits their function as sensors. While current SRR methods can increase the MM Q-factor to a certain level, the Q-factor must be further enhanced to meet the need of ultra-sensitive bio- and chemical sensors. This new nanowire-based CRR design shows significantly enhanced Q-factor and sensitivity. The CRR nanopillar based MMs to excite the inductive-capacitive resonance via displacement current, which has a higher Q factor than typical thin film based MMs.

BENEFITS AND FEATURES:

- Extremely high Q factor: expected to be 1000x better than conventional thin film SRRs
- Reduces ohmic loss
- Increases energy in electric field due to enlarged surface area
- Enhances sensitivity

APPLICATIONS:

- Detection of chemicals, biomaterials, temperature, strain, alignment and position
- Spectroscopy
- Security screening
- Biosensors and chemical sensors where high Q factor is crucial
- “Lab-on-chip" microsystems

Phase of Development - Concept

Researchers

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Publications

Fabrication of Nanopillar-Based Split Ring Resonators for Displacement Current Mediated Resonances in Terahertz Metamaterials.

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Displacement Current Mediated Resonances in Terahertz Metamaterials

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