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Title: A Compact Thin-Film Sensor Based on Nested Split-Ring-Resonator (SRR) Metamaterials for Microwave Applications
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Abstract: In this paper, we propose a novel metamaterial-based microwave thin-film sensor that incorporates multiple split ring resonators in a compact nested structure. The special feature of the proposed sensor is that the nested SRR structure has more split gaps than the classical SRR structure. The sensing performances are numerically investigated using a three-dimensional full-wave electromagnetic solver based on the finite integral method. The simulated results show that comparing with the traditional SRR structure, the nested SRR structure has low operating frequency (corresponding to a miniaturization by 22.6% in size), low nonlinearity error, and high sensitivity. At the same time, these results demonstrate that our metamaterial design may be well suited for biosensing. Moreover, the proposed structures provide more design flexibility. It can be extended to the terahertz frequency range, which will open a new route for metamaterial application toward sensing of chemical and biomedical molecules with different mass concentrations as well as detecting chemical reaction.