

Tunable and Nonlinear Metamaterial Composites

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After spending more than a decade showing the promise of artificially structured metamaterials that are mostly passive and linear, the community is now putting forth significant efforts into active, tunable and nonlinear metamaterials. These functional metamaterials connect the electronic and other fundamental properties of a material with the metamaterial structure to introduce unprecedented control of electromagnetic waves. As the metamaterials field fuses with plasmonics and nanophotonics, more emphasis is being placed on the nano-interfaces between materials, which can surprisingly dominate the electromagnetic behavior of the composite. An example is the enormous enhancement of second harmonic generation in nanostructured metallic metamaterials, in which the hydrodynamic properties of the free electron gas in the metal interacts with the nanosurface to achieve the necessary symmetry. We will describe several examples, showing how the physics of materials can be leveraged to form dynamic, nonlinear or tunable metamaterial composites.

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