Optomechanical Metasurfaces

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The microscopic arrangement of a material's components on the nanoscale determines its macroscopic properties, for example, graphite and diamond derive vastly different properties from different arrangements of the same carbon atoms. Here we rearrange the subwavelength-scale building blocks of metamaterials in order to achieve dynamic control over metamaterial properties. Nanomechanical metamaterials may be actuated by temperature changes, electric and magnetic signals as well as light, resulting in substantial changes of their optical characteristics.

Here we focus on light-actuated metamaterial devices, which consist of photomechanically-responsive nanostructures, offering a novel, giant optomechanical nonlinearity, the magnitude, speed and spectral position of which can be engineered. The underlying light-matter interaction leads to structural strain and converts optical energy into mechanical work. Resulting phenomena include modulation of light with light, optical bistability and directionally asymmetric transmission of light.