Dielectric Resonances in Hexagonal Boron Nitride Nanodisks

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High-index nanomaterials play a substantial role in the enhancement of optical effects based on electric and magnetic Mie resonances. While hexagonal boron nitride (hBN) has been heavily explored within the Reststrahlen bands (RB) as a natural hyperbolic phonon polariton material [1], close to the transversal optical modes outside the RB the dielectric constant has extremely high positive values. The latter provides the opportunity of producing dielectric resonators with very large dielectric constants. We report infrared Mie resonances of hBN nanodisks (NDs). Reflection and transmission spectra of hBN NDs of different sizes have been investigated to understand Mie resonances within the infrared range. We show the presence of a strong magnetic dipole resonance which energy and strength depends on the size and geometry of the hBN NDs as well as the substrate properties. Finite element modeling of the electromagnetic fields has been performed and is in excellent agreement with our experimental results. Numerical and experimental data have indicated that by selecting the proper substrate thickness and hBN NDs radius, much more prominent Mie resonances are achieved. Mie resonances provide an opportunity to easily manipulate light confinement for the design of optical devices such as nanoresonators, nanolasers, highly efficient metasurfaces and ultrafast metadevices.

[1] Caldwell, Joshua D., et al. "Sub-diffractional volume-confined polaritons in the natural hyperbolic material hexagonal boron nitride." *Nature communications* 5.1 (2014): 5221.

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