All-dielectric Nano-optomechanical Nonlinear Metamaterials

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A free-standing all-dielectric metamaterial can act as nonlinear medium at optical telecommunications wavelengths. We show that the resonant nature of localized electromagnetic and mechanical oscillation modes in a nanostructured silicon membrane provide for the realization of extremely large optomechanical nonlinearities, operating at intensities of only a few μW per unit cell and modulation frequencies in the hundreds of MHz range, thereby offering a path to fast, compact all-optical metadevices.