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Engineering high-k with metamaterial plasmonic structures XUEYUAN WU, JIANTAO KONG, DAVID BROIDO, MICHAEL J. NAUGHTON, KRZYSZTOF KEMPA, Boston College — Metamaterial plasmonic composites offer remarkable flexibility in controlling effective dielectric properties of matter. These composites rely on trapped plasmonic resonances in metallic micro- or nanostructures embedded in dielectric or semiconducting matrices. Such composites can have very large and/or low effective dielectric functions at various frequencies, depending on the composite design. Recently, an aluminum nanoparticle composite engineered to have vanishing dielectric function at the electron-phonon interaction band achieved 3-fold increase of the superconducting Tc [1]. In the electronics industry, there is a need for materials with large (and largely real, to minimize losses) low frequency dielectric function, called high-k materials. We demonstrate that metamaterial plasmonic composites with enhanced self-inductance can be used to make high-k composites without heavy metal loading, confirming an earlier theoretical study [2].
[1] V.N. Smolyaninova, et al., "Using metamaterial nanoengineering to triple the superconducting critical temperature of bulk aluminum", Scientific Reports 5, 15777 (2015). [2] K. Kempa, "Dielectric function of media based on conductive particles". Phys. Rev. B **74**, 033411 (2006).

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