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Resonant Optical Forces in Silicon Carbide Nanostructures
DONGFANG LI, RASHID ZIA, Brown University — Silicon carbide (SiC) materials are widely used for their exceptional electronic, mechanical, and thermal properties. For example, given its high stiffness to density ratio, SiC is an ideal material for mechanical resonators, and it has been explored for applications in nanoelectromechanical systems (NEMS). SiC also supports strong surface phonon-polariton resonances in the infrared region, which could enable its use for optomechanics. Similar to surface plasmon-polaritons supported by metal-dielectric interfaces, these surface waves at a SiC-vacuum interface can be used to guide and confine intense electromagnetic energy. Here, we investigate the resonant optical forces induced by phonon-polariton modes in different SiC nanostructures. Specifically, we calculate optical forces using the Maxwell Stress Tensor for three geometries: spherical particles, slab waveguides, and rectangular waveguides. We find that the high quality factor phonon-polariton modes in SiC can produce very large forces, more than two orders of magnitude larger than the plasmonic forces in similar metal nanostructures. These strong resonant forces, combined with its mechanical and thermal properties, make SiC a promising material for optomechanical applications.

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