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Near-Field Radiation Between Graphene-Covered Carbon Nanotube Arrays RICHARD ZHANG, XIANGLEI LIU, ZHUOMIN ZHANG, Georgia Institute of Technology, NANOSCALE THERMAL RADIATION LABORATORY TEAM — It has been shown that at nanometer gap distances, or the near-field, thermal radiation is enhanced over blackbody between hyperbolic metamaterials. It was shown that vertically aligned carbon nanotube (VACNT) arrays in the near-field demonstrate exceptional enhancement. In this study, graphene is covered on the surfaces of two semi-infinite VACNT arrays separated by a sub-micron vacuum gap. Doped graphene ($\mu \geq 0.3\,\text{eV}$) is found to improve photon tunneling in a broad hyperbolic frequency range, due to the interaction with graphene-graphene surface plasmons. Increasing doping that shifts the peak spectral heat flux toward higher frequencies attests to the tunable bandgap of graphene. Although graphene covering of VACNT does not offer many magnitudes of near-field heat flux enhancement over uncovered VACNT, this study identifies conditions (i.e. gap distance and doping) that best augments heat transfer to that of VACNT arrays. In addition, this study demonstrates the near-field Poynting vector to determine the energy absorption due to graphene. It is found that graphene, in low frequencies and high chemical potentials, attenuates large penetration depths of hyperbolic modes, thereby increasing the contribution of graphene-graphene surface plasmons. This study has an impact toward designing carbon-based emitters and thermal junctions.

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