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Active Extraction of Near-field Thermal Radiation DING DING, TAEYONG KIM, AUSTIN MINNICH, Caltech — Radiative heat transport between materials supporting surface-phonon polaritons is greatly enhanced when the materials are placed at sub-wavelength separation as a result of the contribution of near-field surface modes. However, the enhancement is limited to small separations due to the evanescent decay of the surface waves. In this work, we propose and numerically demonstrate an active radiative cooling (ARC) scheme to extract these modes to the far-field. Our approach exploits the monochromatic nature of near-field thermal radiation to drive a transition in a laser gain medium, which, when coupled with external optical pumping, allows the resonant surface mode to be emitted into the far-field. We also provide further insights into our ARC scheme by applying the theoretical framework used for laser cooling of solids (LCS) to ARC. We show that LCS and ARC can be described with the same mathematical formalism by replacing the electron-phonon coupling parameter in LCS with the electron-photon coupling parameter in ARC. Using this framework, we examine the predictions of the formalism for LCS and ARC using realistic parameters and find that ARC can achieve higher efficiency and extracted power over a wide range of conditions. Our study demonstrates a new approach to manipulate near-field thermal radiation for thermal management.

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