Radiative Heat Transfer in Polaritonic Nanoparticle Beds

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Abstract

Researchers have repeatedly shown that electromagnetic surface modes can enable near-field radiation heat transfer between two bodies well above the blackbody limit. Recent theoretical works predict that these modes could also increase thermal conduction through arrays of nanostructures. To observe this effect, we measure the thermal conductivity of packed nanoparticle beds with different coatings, and we resolve thermal conductivities more than three times higher than those of the packed beds’ constituent materials. Dispersion relations for coupled surface modes are compared to the emitted field from nanoparticle arrays calculated with the fluctuation dissipation theorem, which shows that thermal transport in our nanoparticle beds cannot be due to propagating modes. An overview of surface modes and their applicability to thermal transport will also be presented.