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Tailoring Self-Assembled Metallic Photonic Crystals for Modified Thermal Emission SANG EON HAN, Department of Chemical Engineering and Materials Science, University of Minnesota, ANDREAS STEIN, Department of Chemistry, University of Minnesota, DAVID NORRIS, Department of Chemical Engineering and Materials Science, University of Minnesota — Photonic crystals are solids that are periodically structured on an optical length scale. Previous work has shown that specific photonic crystal structures can lead to changes in the thermal emission spectra of a material. This may allow elimination of unwanted heat from emission sources, such as tungsten filaments in conventional light bulbs, or lead to new materials for thermophotovoltaics. Here, we study the possibility that metallic photonic crystals obtained via self-assembly can modify thermal emission. These structures, known as inverse opals, are easy to fabricate. However, experiments on tungsten inverse opals suggest that they also have strong optical absorption. In this case, the light does not interact sufficiently with the periodicity of the crystal and modification of thermal emission does not occur. We consider the origin of this effect and show theoretically how to tailor both absorption and surface coupling in experimentally realizable metallic inverse opals. Calculations for tailored inverse opals made from tungsten, molybdenum, and tantalum show that their optical properties can be similar to or even better than the tungsten woodpile structure, which has previously shown modified thermal emission.

Sang Eon Han
University of Minnesota

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