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Nanoscale Fin Effects in Heat Transfer at the Fluid-Solid Interface YUANHAO LI, GERALD WANG, Carnegie Mellon University — Nanoscale heat transfer at a fluid-solid interface can exhibit surprising behaviors that have no macroscopic analog. In this talk, we present results from molecular-dynamics (MD) simulations in which we study the heat-transfer performance of surfaces patterned with nanoscale fins, in systems held at a fixed thermal gradient. Such problems are relevant for understanding thermal transport properties of interfaces featuring nanoscale patterns or nanomaterial coatings. In MD simulations of a simple fluid, we find that nanoscale fins can induce significant fluid structuring effects as well as anomalous fluid diffusion at the fluid-solid interface. We show that the magnitudes of these effects can be accurately captured using recently developed models. We also present results on the heat transfer coefficient in the system as a function of the thermal gradient, the fluid density, and the fin geometry (size and aspect ratio); these results differ in several ways from the results of classical fin theory, in part due to fluid layering effects. We rationalize these results by examining the vibrational density of states in the vicinity of the fluid-solid interface.

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