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Thermal conductance of hydrophilic and hydrophobic interfaces
ZHENBIN GE, PAUL BRAUN, DAVID CAHILL, University of Illinois at Urbana-Champaign — Interfaces between water and hydrophilic or hydrophobic surfaces are of great importance for many biological and engineering systems. Using time-domain thermoreflectance, we have measured the transport of thermally-excited vibrational energy across planar interfaces between water and solids that have been chemically functionalized using self-assembled monolayer. The thermal conductance per unit area of the interface G for hydrophobic Al or Au surface in water is determined to be 37 to 55 MW m^{-2} K^{-1}. G for hydrophilic Al or Au surface in water is 150 to 300 MW m^{-2} K^{-1}. Our new work on thermal transport complements the extensive research literature on momentum transport at aqueous interfaces: the Kapitza length—i.e., the thermal conductivity of water divided by the thermal conductance per unit area of the interface—is analogous to the "slip-length" for water flowing tangentially past a solid surface. We find that the Kapitza length at hydrophobic interfaces (11-16 nm) is a factor of 3-8 larger than the Kapitza length at hydrophilic interfaces (2-4 nm); a change of terminal group from methyl to hydroxyl increases the Kapitza length by approximately 10 nm.

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