Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Noncontinuum Effects in Gas-Phase Heat Transfer in Microdevices M.A. GALLIS, J.R. TORCZYNSKI, D.J. RADER, B.L. BAINBRIDGE[1] — Noncontinuum gas-phase heat transfer is simulated for two microscale geometries using two methods. Microscale thermal actuation from heating-induced expansion of a microbeam adjacent to the substrate and surrounded by air is the motivation. The first geometry is a 1-μm gas-filled microgap bounded by parallel solid slabs. The second geometry is a heated I-shaped microbeam 2 μm from the adjacent substrate, with gas in between. Two computational methods are used. The Navier-Stokes slip-jump method approximates noncontinuum effects with continuum heat transfer in the bulk gas and temperature jumps at boundaries. The Direct Simulation Monte Carlo method treats noncontinuum gas behavior more accurately by using computational molecules. The heat fluxes from both methods for the microgap agree closely for all pressures and accommodation coefficients. For the microbeam, there is good agreement except for low-pressure cases with near-unity accommodation coefficients. The causes of this discrepancy are discussed. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

[1]Sandia National Laboratories

J. R. Torczynski
Sandia National Laboratories

Date submitted: 28 Jul 2005 Electronic form version 1.4