Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Thermal conductivity of amorphous silicon films JOSEPH FELDMAN, XIAO LIU, Naval Research Laboratory, R. CRANDALL, National Renewable Energy Laboratory, N. BERNSTEIN, M. MEHL, D. PAPACONSTANTOPOULOS, Naval Research Laboratory — We measured the thermal conductivity of an 80 μm thick amorphous silicon film from 80K to room temperature. The amorphous silicon sample was prepared by hot-wire chemical-vapor deposition with 1 at. % hydrogen, which was found previously to contain almost no atomic tunneling states that is common in amorphous solids. The value of the thermal conductivity is about a factor of two larger than previous results. To explain this unusually large thermal conductivity, we report on a Kubo theory that makes use of a tight binding electronic structure of a 1000 atom model. We include the low frequency modes that the Kubo model does not take into account because of its finite size. By considering Rayleigh and boundary scattering, and scattering of tunneling states, our theory can explain not only our result but also previous ones as well. We conclude that the large thermal conductivity of our film is attributed to the lack of scattering of the low frequency modes by the tunneling states. Therefore, low frequency modes can make significant contribution to heat transport even at near room temperature.

Xiao Liu
Naval Research Laboratory

Date submitted: 30 Nov 2007 Electronic form version 1.4