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Thermal Conductivity of Metallic Nanowires near Room Temperature N. STOJANOVIC, J. BERG, Texas Tech University, D.H.S. MAITHRIPALA, University of Peradeniya, M. HOLTZ, Texas Tech University — In metallic structures with nanoscale dimension both electrical and thermal conductivities are significantly different from their bulk counterparts. The total thermal conductivity is generally the sum of the electronic and phonon contributions. We examine electron and phonon heat transport in metals, in the temperature range near to or above the Debye temperature, where it is generally assumed that phonon component is negligible for metals, an assumption that has not been subjected to rigorous experimental verification, particularly at the nanoscale, due to difficulties in direct measurement of thermal conductivity. Experimental evidence suggests that the Wiedemann-Franz (W-F) law breaks down at the nanoscale. The neglected phonon component is one factor that has been cited as contributing to the apparent discrepancy in W-F. Another factor is inelastic electron-phonon scattering that influences transport due to a temperature gradient, but not due to an electric field. We report experimental results for Al nanowires and develop a model based on the Boltzmann transport equation for size dependence of electrical and thermal conductivity in nanowires. The model is validated with available data reporting direct measurements of thermal conductivity of nanowires, ribbons, and thin films. The W-F law and Lorenz factor are examined and a modified version of W-F is presented, corrected for these two factors and valid from macro- to nanoscale provided characteristic sizes exceed the phonon mean free path.

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