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Surface scattering in metallic nanowires XI CHEN, Department of Physics, University of Minnesota, RANDALL VICTORA, Department of Electrical and Computer Engineering, University of Minnesota — We theoretically study the electronic transport with surface scattering in metallic nanowires. The Landauer formula along with a recursive Green's function technique is employed to calculate the transport properties of wires with surface disorder. In the diffusive regime, the resistance increases linearly with the wire length, with a slope determined by the elastic mean free path (MFP). For strong scattering, MFP grows linearly with the wire diameter in a way that violates the semi-classical Fuchs-Sondheimer model. The mechanism for the violation is discussed. In the weak scattering limit, MFP grows with the diameter in an oscillatory manner owing to the quantum size effect. We propose an analytical theory that explains the observed behavior. The MFP is also shown to strongly depend on the surrounding environment of the nanowire. For wires with realistic sizes, we quantitatively show that the surface scattering alone can cause a resistivity that is several times larger than the bulk value. This work is supported by the National Science Foundation under Award Number ECS-0621868 and by the University of Minnesota Supercomputing Institute.

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