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Origin of nonlinear current-voltage characteristics in nanowires

FRANCOIS LEONARD, A. ALEC TALIN, B. S. SWARTZENTRUBER, Sandia National Laboratories, XIN WANG, STEPHEN D. HERSEE, University of New Mexico — The current-voltage characteristics of nanowires are often observed to be nonlinear, and this behavior has been ascribed to Schottky barriers at the contacts. We present electronic transport measurements on GaN nanowires and demonstrate that the nonlinear behavior originates instead from space-charge limited current. Analysis of published experimental data in several nanowire materials shows that this behavior is common, and should be expected whenever diffusive transport dominates and the effective carrier concentration is low. A theory of space-charge limited current in nanowires is presented, and correctly predicts the scaling of the current with the nanowire aspect ratio.

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