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Contactless, high-throughput determination of electrical conductivity of one-dimensional nanomaterials by solution-based electro-orientation spectroscopy CEVAT AKIN, JINGANG YI, LEONARD FELDMAN, JERRY SHAN, Rutgers University, CORENTIN DURAND, SABAN HUS, AN-PING LI, Oak Ridge National Laboratory, MICHAEL FILLER, Georgia Institute of Technology — The electrical-transport properties of nanowires of the same composition (and even fabricated within the same batch) often vary by orders of magnitude. Existing characterization methods are slow, making the large number of measurements needed to statistically characterize highly variable samples essentially impossible. Here, we demonstrate a contactless, solution-based method to efficiently determine the electrical conductivity of individual 1D nanomaterials. This new method, electro-orientation spectroscopy, is based on the transient alignment behavior of fluid-suspended nanowires in AC electric fields of different frequencies. Comparison with direct transport measurements by probe-based scanning tunneling electron microscopy shows that electro-orientation spectroscopy can quantitatively measure nanowire conductivity over a 6-order-of-magnitude range, 10^{-5} – 10 S/m. We demonstrate an automated microfluidic device capable of measuring and sorting hundreds of nanowires per hour. With this device, we statistically characterize the conductivity of a variety of nanowires and find significant variability in Si nanowires grown from the same wafer by metal-assisted chemical etching. Finally, we discuss the potential of the electro-orientation approach to be integrated with other solution-based methods for scalable positioning of nanowires for post-growth device assembly.

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