Time-dependent universal conductance fluctuations in metal oxide nanowires due to mobile defects

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Time-dependent universal conductance fluctuations (UCF) are observed in single RuO_2 nanowires (∼50–100 nm in diameter and a few micrometers long) at cryogenic temperatures.[1] The fluctuations persist up to unprecedentedly high temperatures of ∼10 K. Their root-mean-square fluctuation amplitudes increase with decreasing temperature, reaching a fraction of e^2/h at temperatures below ∼2 K. These fluctuations are shown to originate from scattering of conduction electrons with rich amounts of mobile defects in artificially synthesized metal oxide nanowires. Furthermore, time-dependent UCF characteristics in both one-dimensional saturated and unsaturated regimes are identified, in quantitative consistency with existing theoretical predictions.[2] In another case of single IrO_2 nanowires where the mobile defects are less vigorous, time-independent UCF as a function of varying magnetic fields are clearly observed. The variation in the fluctuation amplitude with temperature can be understood in terms of current theoretical concepts, but a quantitative explanation is still lacking.

[1]A. S. Lien, L. Y. Wang, C. S. Chu, and J. J. Lin, to be published.
[2]S. Feng, in *Mesoscopic Phenomena in Solids*, edited by B. L. Altshuler, P. A. Lee, and R. A. Webb (North-Holland, Amsterdam, 1991).