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Making quantum devices with electrical properties that are robust to thermal cycling using AlGaAs/GaAs HIGFET structures ADAM MICOLICH, ANDREW SEE, OLEH KLOCHAN, ADAM BURKE, ALEX HAMILTON, School of Physics, The University of New South Wales, Sydney NSW 2052, Australia, IAN PILGRIM, BILLY SCANNELL, RICK MONTGOMERY, RICHARD TAYLOR, Department of Physics, University of Oregon, Eugene OR 97403, MARTIN AAGESEN, POUL LINDELOF, Nanoscience Center, Niels Bohr Institute, Copenhagen, Denmark, IAN FARRER, DAVID RITCHIE, Cavendish Laboratory, Cambridge, U.K. — The transport properties of quantum devices on modulation-doped AlGaAs/GaAs heterostructures change after thermal cycling above ∼130 K due to charge redistribution in the modulation doping layer. This is particularly evident in a quantum dot's magnetoconductance fluctuations (MCF) which provide a sensitive fingerprint of electron trajectories through the dot. We show that the MCF become reproducible with high-fidelity after thermal cycling to 300 K in quantum dots made using AlGaAs/GaAs heterostructures without modulation doping. This is achieved by populating the dot electrostatically using a Heterostructure Insulated Gate Field Effect Transistor (HIGFET) architecture. Our result demonstrates ionized impurity scattering has a measurable effect on transport in quantum dots, even in the ballistic transport regime. It highlights the potential for HIGFET-based architectures to provide devices with significantly reduced small-angle scattering at equivalent transport mobility, and more thermally robust electrical properties. More broadly, we suggest a quantum dot's MCF may be a useful tool for studying the temporal/thermal stability of disorder in other semiconductor materials.

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