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Stability of metallic single-electron devices with plasma oxidized, cobalt confined AlO_x tunnel barriers Y. X. HONG, ZAC BARCIKOWSKI, A. N. RAMANAYAKA, ROY MURRAY, M. D. STEWART, JR., NEIL M. ZIMMERMAN, J. M. POMEROY, National Institute of Standards and Technology, QUANTUM PROCESSES AND METROLOGY GROUP TEAM — Single-electron transistors (SETs) are fabricated by double-angle deposition in order to measure the electrical stability in the plasma oxidized, cobalt confined aluminum oxide (AlO_x) barriers, as an estimate of the two-level fluctuator density compared with thermal oxidation. The electrical stability of metal-based SETs and superconducting devices suffers from oxide-induced high defect densities and long-term charge offset drift. These devices are typically made with thermal AlO_x. Our tunnel junctions have two physical differences from those of thermal oxides: 1) plasma oxidation is shown to be more uniform and stoichiometric for AlO_x than thermal oxidation; and 2) high oxygen content is confined within the insulating regions by using a $Co/AlO_x/Co$ structure to provide a barrier against oxygen diffusion. In our prior work with large-area tunnel junctions, these AlO_x barriers sandwiched between cobalt layers exhibit better long-term resistance stability. In this work, we are developing SETs by double-angle deposition as a path toward low-capacitance and small-area $Co/AlO_x/Co$ tunnel junctions. We expect better charge offset stability on these devices than typical thermally oxidized devices with unconfined oxygen.

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