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Superconducting qubits with semiconductor nanowire Josephson junctions[1] K.D. PETERSSON, T.W. LARSEN, F. KUEMMETH, T.S. JESPERSEN, P. KROGSTRUP, J. NYGÅRD, C.M. MARCUS, Center for Quantum Devices, Niels Bohr Institute, Denmark — Superconducting transmon qubits are a promising basis for a scalable quantum information processor.[2] The recent development of semiconducting InAs nanowires with *in situ* molecular beam epitaxy-grown Al contacts presents new possibilities for building hybrid superconductor/semiconductor devices using precise bottom up fabrication techniques.[3] Here, we take advantage of these high quality materials to develop superconducting qubits with superconductor-normal-superconductor Josephson junctions (JJs) where the normal element is an InAs semiconductor nanowire. We have fabricated transmon qubits in which the conventional Al-Al_2O_3-Al JJs are replaced by a single gate-tunable nanowire JJ. Using spectroscopy to probe the qubit we observe fluctuations in its level splitting with gate voltage that are consistent with universal conductance fluctuations in the nanowire's normal state conductance.[4] Our gate-tunable nanowire transmons may enable new means of control for large scale qubit architectures and hybrid topological quantum computing schemes.

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[2]R. Barends *et al.*, Nature **508**, 500-503 (2014).
[3]P. Krogstrup *et al.*, Nature Materials, *in press.*
[4]Y.-J. Doh *et al.*, Science **309**, 272-275 (2005).

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