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Superconducting-semiconducting nanowire hybrid microwave circuits[1] G. DE LANGE, QuTech and Kavli Institute of Nanoscience, Delft University of Technology, P.O. Box 5046, 2600 GA Delft, The Netherlands, B. VAN HECK, Instituut-Lorentz, Universiteit Leiden, P.O. Box 9506, 2300 RA Leiden, The Netherlands, A. BRUNO, D. VAN WOERKOM, A. GERESDI, QuTech and Kavli Institute of Nanoscience, Delft University of Technology, P.O. Box 5046, 2600 GA Delft, The Netherlands, S. R. PLISSARD, E. P. A. M. BAKKERS, Eindhoven University of Technology, 5612 MB Eindhoven, The Netherlands, A. R. AKHMEROV, L. DICARLO, QuTech and Kavli Institute of Nanoscience, Delft University of Technology, P.O. Box 5046, 2600 GA Delft, The Netherlands — Hybrid superconducting-semiconducting circuits offer a versatile platform for studying quantum effects in mesoscopic solid-state systems. We report the realization of hybrid artificial atoms based on Indium-Arsenide nanowire Josephson elements in a circuit quantum electrodynamics architecture. Transmon-like single-junction devices have gate-tunable transition frequencies. Split-junction devices behave as transmons near zero applied flux and as flux qubits near half flux quantum, wherein states with oppositely flowing persistent current can be driven by microwaves. This flux-qubit like behaviour results from non-sinusoidal current-phase relations in the nanowire Josephson elements. These hybrid microwave circuits are made entirely of magnetic-field compatible materials, offering new opportunities for hybrid experiments combining microwave circuits with polarized spin ensembles and Majorana bound states.

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