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Proximity semiconducting nanowire junctions from Josephson to quantum dot regimes KAVEH GHARAVI, GREGORY HOLLOWAY, JONATHAN BAUGH, Institute for Quantum Computing, University of Waterloo — Experimental low-temperature transport results are presented on proximity-effect Josephson junctions made from low bandgap III-V semiconductor nanowires contacted with Nb. Two regimes are explored in terms of the Nb/nanowire interface transparency t. (i) High t allows a supercurrent to flow across the junction with magnitude I_c, which can be modulated using the voltage V_g on a global back gate or a local gate. Relatively high values are obtained for the figure-of-merit parameter $I_c R_N/(e\Delta) \sim 0.5$, and $t \sim 0.75$, where R_N is the normal state resistance and Δ the superconducting gap of the Nb leads. With the application of an axial magnetic field, I_c decays but exhibits oscillations before being fully suppressed. The period and amplitude of the oscillations depend on V_g. Possible explanations for this behaviour are presented, including Josephson interference of the orbital subbands in the nanowire. (ii) Lower transparency correlates with a spontaneous quantum dot (QD) formed in the nanowire channel. Pairs of Andreev Bound States (ABS) appear at energies $|E| < \Delta$, with one pair unexpectedly pinned at $E = 0$ for a wide range of V_g. A description of the QD-ABS system beyond the Anderson model is presented to explain the latter results.

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