InAs Nanowire Josephson Field Effect Transistors


— We have fabricated superconducting nano-junctions using InAs nanowires contacted with Al superconducting electrodes. The diameter of nanowire is about 70 nm with source-drain spacing of 200 nm. Low Ohmic metallic contacts are formed at the interface with typical $R_N A$ value of $3 \times 10^{-7} \Omega \text{ cm}^2$. Below the superconducting transition temperature $T_C = 1.1 \text{ K}$, the devices show clear conductance enhancements below the superconducting gap $2\Delta_0 = 210 \mu\text{eV}$, which is explained by multiple Andreev reflection. Near zero-bias voltage, conductance diverges to show supercurrent in V(I) curve. Maximum critical current is about $I_C = 130 \text{nA}$ at $T = 30 \text{ mK}$ with $I_C R_N$ product of $60 \mu\text{V}$. Irradiated with microwave, constant voltage plateaus are observed satisfying ac Josephson relation. By applying back-gate voltage, critical currents are suppressed to be zero near pinch-off gate voltage $V_g = -70 \text{ V}$. Universal conductance fluctuations of nanowire and its corresponding critical current fluctuations are discussed from the viewpoint of truly mesoscopic Josephson field effect transistors.