MAR07-2006-001766

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Mesoscopic Josephson Junctions Employing Ge/Si Core/Shell Nanowires[1]

ANDY VIDAN, MIT Lincoln Laboratory

Semiconductor nanowires are finding increased importance in nanoelectronics due to their controlled growth and reduced dimensions. Band structure engineering of heterostructure nanowires is proving to be instrumental in creating low-dimensional carrier gases with enhanced mobility, low scattering and reproducible contacts. We present low temperature transport measurements of one-dimensional hole gases formed in (undoped) germanium/silicon (Ge/Si) core/shell heterostructure nanowires. The Ge core diameter of the nanowires is 15 nm with a 2 nm Si shell. The length of the nanowire between the contacts is typically 150 nm. Transparent contacts to the nanowires allow observation of transport through one-dimensional subbands arising from radial confinement. When connected to superconducting aluminum leads, a dissipationless supercurrent flows through the semiconductor nanowire due to proximity-induced superconductivity. By using a Au top gate, which modulates the carrier density of the nanowire and the number of one-dimensional subbands populated, the critical current of these mesoscopic Josephson junctions can be tuned from zero to greater than 100 nA. Resonant multiple Andreev reflections in the superconductor-nanowire-superconductor system is also observed. Finally, we investigate the interplay between one-dimensional quantum confinement and superconductivity.

[1]This work was performed in collaboration with Jie Xiang, Charles M. Lieber, M. Tinkham, and R.M. Westervelt at Harvard University.