Single-Mode Cooper Pair Channel in LaAlO$_3$/SrTiO$_3$ Nanowires

JOSHUA VEAZEY, GUANGLEI CHENG, PATRICK IRVIN, MENGCHEN HUANG, U. of Pittsburgh, CHUNG WUNG BARK, SANGWOO RYU, CHANG-BEOM EOM, U. of Wisconsin-Madison, JEREMY LEVY, U. of Pittsburgh — The conducting LaAlO$_3$/SrTiO$_3$ interface becomes superconducting$^1$ below a critical temperature $T_c \sim 100$-$400$ mK. Here, we investigate the transport characteristics of LaAlO$_3$/SrTiO$_3$ structures formed from $\sim 10$ nm-wide nanowire segments produced by a conductive atomic force microscope lithography technique$^2$. Above $T_c \sim 200$ mK we find a characteristic four-terminal conductance $G \sim e^2/h$ that is independent of the channel length. Below $T_c$ we find that the conductance increases to $G \sim 4e^2/h$. This increase is attributed to the formation of Cooper pairs that propagate in a single mode. We also discuss the interactions between Cooper pairs and spin-polarized transport in these structures. This work is supported by AFOSR (FA9550-10-1-0524).