Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Hard proximity induced superconducting gap in semiconductor-superconductor epitaxial hybrids[1] THOMAS JESPERSEN, PETER KROGSTRUP, NINO ZIINO, SVEN ALBRECHT, WILLY CHANG, MORTEN MADSEN, Center for Quantum Devices, Niels Bohr Institute, University of Copenhagen, Denmark, ERIK JOHNSON, Department of Wind Energy, Technical University of Denmark, Risø Campus, Roskilde, Denmark, FERDINAND KUEMMETH, JESPER NYGÅRD, CHARLES MARCUS, Center for Quantum Devices, Niels Bohr Institute, University of Copenhagen, Denmark — We present molecular beam epitaxy grown InAs semiconductor nanowires capped with a shell of aluminum (superconductor). The hybrid wires are grown without breaking vacuum, resulting in an epitaxial interface between the two materials as demonstrated by detailed transmission electron microscopy and simulations. The domain matching at the interface is discussed. Incorporating the epitaxial nanowire hybrids in electrical devices we performed detailed tunneling spectroscopy of the proximity induced superconducting gap in the InAs core at 20 mK. We find the sub-gap conductance being at least a factor 200 smaller than the normal state value (gap hardness). This is a significant improvement compared to devices fabricated by conventional lithographic methods and metal evaporation showing no more than a factor of ~ 5. The epitaxial hybrids seem to solve the soft gap problem associated with the use of nanowire hybrids for future applications in topological quantum information based on Majorana zero modes.

[1]Research supported by Microsoft Station Q, Danish National Research Foundation, Villum Foundation, Lundbeck Foundation, and the European Commission.

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Date submitted: 14 Nov 2014 Electronic form version 1.4