Measuring the Density of States of Conduction Sub-band in InAs Nanowires at Room Temperature

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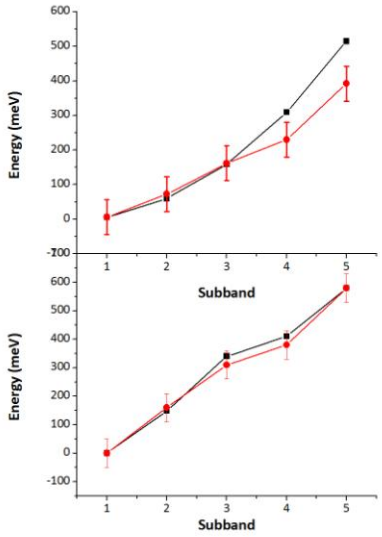
InAs nanowires are candidates for future high-speed electronic and optoelectronic applications due to their high electron mobility and large coherence length. Moreover, InAs possesses a large Bohr radius (~34 nm), which can lead to quantum confinement effects at growth-accessible radii. As a result, one-dimensional (1D) subbands are expected to form, with observable energy separation. Recent transport measurements have revealed the presence of subbands, albeit at low temperatures. Here we report of the mapping of subbands energies, as well as the corresponding density of states (DOS) at room temperature, using Kelvin Probe Force Microscopy (KPFM). Nanowires were grown by molecular beam epitaxy, with high purity, and fabricated as field-effect transistors. The KPFM measurements were carried on a grounded nanowire, with changing gate bias, which shifts the Fermi level through the conduction subbands. The result is a dependence of Fermi level vs. gate bias, from which the subband splitting and corresponding DOS are directly extracted.



Conduction subbands energies – measurement (red) compared with theory (black), at two different diameters: 20 nm (top) and 14 nm (bottom).