

Size Effect on the Mechanical Properties of Nanowires

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As the size of material decreases, the fundamental properties of material such as Young's modulus become a function of size and are very much different from properties at the bulk scale. New phenomena begin to emerge at the micro and nano scale. In this research, we study the effect of size on the mechanical properties of nanowires. In order to perform experiments on single nanowires, we have devised an experimental test-bed with very high force and displacement resolution (nano-Newton and nanometer respectively). The small size of the test-bed enables us to perform the experiments in electron microscopes so that we can visualize the nanowire during the experiment. We have performed mechanical characterization experiments on zinc oxide nanowires to measure the Young's modulus and fracture strain of the nanowires. The properties of the nanowire are different from bulk zinc oxide and we suggest possible mechanisms such as charge redistribution and surface effects to explain these differences.