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Mechanical behavior of GaAs nanowires

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Nanowires (NWs) are of structures with diameters usually constrained to the range of nanometres and unconstrained lengths, resulting in quantum mechanical effects in two dimensions. NWs have significant applications as nanoscale interconnects and active components of electronic, optoelectronic nano-devices. While the synthesis/growth and the physical properties of NWs have been extensively investigated, the mechanical properties, especially the effects of nano-size dimensions on the mechanical properties have been largely overlooked up to now due to the difficulty of the mechanical characterization of nanoscale objects. However, understanding the mechanical behavior of NWs as a function of NW diameter is extremely important, especially in semiconductor NWs, because the reliability and even functionality of NW-based devices can depend on the mechanical properties of the NWs. The present work is to apply state-of-the-art in-situ deformation transmission electron microscopy techniques to explore outstanding issues on the mechanical behavior of GaAs semiconductor NWs. Results show that the mechanical behavior of GaAs NWs changes with diameters from several hundred nanometers to several nanometers. The elastic strain of GaAs NWs can be ~11%, which is 100 times higher than that of its bulk form, that obvious plastic deformation occurs via partial dislocation motion in diameter of 25nm, while bulk GaAs semiconductor is generally brittle at room temperature. With diameter decreasing, a recoverable deformation, a repeatable self-healing process occurred when an external compressive force was removed.

Biography

Yanbo Wang was awarded his PhD in 2008 from Chinese Academy of Sciences. He is working at the University of Sydney as an ARC Future Fellow. He has published more than 60 papers in reputed journals (Nature Mater., Adv Mater., NanoLetter et al) and his papers have been cited 2000 times, with an h-index of 25.

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