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Large Scale Synthesis of Single Crystalline Ultra-long Semiconducting Nanowires for Improved Electronic and Optoelectronic Devices

Advantages
• Fast and easy method for production of cadmium sulfide (CdS) nanowires
• Synthesis takes place at temperatures below 160ºC
• Cost effective and large scale production
• Produces nanowires several times longer than any previous method, with aspect ratios of more than 125 (length to diameter)
• Excellent material for nanoscale electronics, optics and semiconductors

Invention
Methods and materials for the synthesis of manganese doped cadmium sulfide (CdS) nanowires with a wide band gap semiconducting shell and methods for creation of a reaction chamber where said synthesis may take place.

Background
Great efforts have been made to improve upon one dimensional nanostructures ever since the discovery of carbon nanotubes in 1991. One dimensional (1D) nanostructures are critical building blocks in the design of nanoscale electronic and optoelectronic devices. These 1D nanostructures may be used in photonic circuits, LEDs, nanowire lasers, as solar cell absorbing materials and as nanotransistors. Improvements in the efficiency of creating 1D semiconducting nanowires, as well as reduction of surface defects, would greatly enhance the performance of these nanodevices and the electronics which contain them. Current methods utilized for producing these nanostructures are complicated, time consuming, and have only produced very short nanowires. An easy and fast method which produces ultra-long nanowires on a large scale may have immediate industrial and commercial value.

UCF scientists have devised a method for easy and fast synthesis of manganese doped cadmium sulfide (CdS) nanowires. Cadmium sulfide is used because of its excellent semiconducting properties. These nanowires can be coated with a wide band gap semiconducting shell such as zinc sulfide to reduce surface defects and improve overall performance. The technology also provides methods and apparatus for the creation of a reaction chamber that will allow synthesis on a large scale. This method produces ultra-long nanowires (longer than any previous method) with extremely uniform diameter. The possible uses for these nanowires in electronics/optics and other devices are limitless. They could be used as solar absorbing materials, high performance wave guides, LEDs, nanowire transistors, photonic circuits, optic materials and any application requiring nanoscale semiconductors.

Application
Cadmium sulfide nanowires with little to no surface defects could be used in nanoelectronic devices, semiconductor applications and as optical materials. Any company involved in or seeking to produce better, more profitable LEDs, nanowire transistors, photonic circuits, nanoscale semiconductors, solar absorbing materials for solar cells and nanoelectronics would find great, profitable uses for this technology.

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Selected References