Nanowire light-emitters: are these viable sources of coherent light?

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Research in semiconductor nanowires has advanced to the point where these structures are now being considered for nanophotonic devices. For active devices, an ability to manipulate light (by reflection, diffraction, modulation) is usually desirable in the structures. This generally implies that pure nanowires are unlikely to lead to the fabrication of useful nanophotonic devices. In spite of this, a number of papers reporting light emission from semiconductor nanowires have appeared in the literature in the last few years. Most of these nanowires emit spontaneous radiation that usually has a broad spectrum; some nanowires emit radiation that is difficult to categorize as either broad-band spontaneous emission or coherent emission. Some have called this type of emission "laser" emission. This presentation will examine the use of a scheme that uses periodic hterostructures in a nanowire to improve the performance of nanowire emitters; in particular, we discuss what some of the conditions necessary for a nanowire to emit radiation that is "laser-like" are. The structures we discuss are a class of one-dimensional photonic crystals. Properly structured, they should therefore be useful in the design of optical elements, such as a nano-cavity with a high quality factor—a desirable property for a laser oscillation. For many important applications, such as in miniaturized optical sensors or in future chip-scale optical interconnects, nanowire lasers would be much more desirable than "LED-like" emission. The nano-cavity structures we describe could potentially form one of the building blocks of integrated nanophotonics.