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Nanowire lasers go electric

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Scientists have shown for the first time that a single-crystal nanowire can act as an efficient electrically driven laser. Charles Lieber and colleagues at Harvard University believe that such nanoscale lasers could be made to emit over wide range of wavelengths for a variety of applications, including telecommunications and high density data storage (X Duan *et al.* 2003 *Nature* 421 241).

Electrically driven semiconductor lasers are already used for applications but they are costly to fabricate. Moreover, the devices are usually made from compound semiconductors which makes them difficult to integrate into silicon-based systems. To overcome these problems, many researchers have started to investigate alternatives such as nanowire lasers.

A laser requires a population inversion between two energy levels in the system, with the upper level having a higher population than the lower level. This can be achieved by using an external laser to stimulate the material in a method known as "optical pumping". For real applications, however, devices must be electrically, and not optically, driven.

To address this problem, Lieber and co-workers used a single crystal of cadmium sulphide, 80 - 200 nanometres in diameter, for their experiment. Such single crystal wires are attractive building blocks for creating electrically driven lasers because they are defect-free and exhibit superior electrical transport properties. The devices were built by assembling cadmium sulphide on heavily doped silicon.

The Harvard team slowly increased the current through the nanowire and observed a rapid increase in the intensity of the light emitted above about 200 microamps - which corresponds to the onset of lasing. "This is the first time an electrically-driven nanowire laser has been demonstrated," Lieber told *PhysicsWeb*, "Moreover, it is also a first for electrically driven devices assembled from pre-made building blocks."

The researchers believe that their approach could be extended to other materials, such as gallium nitride and indium phosphide nanowires. In this way nanoscale lasers could cover the ultraviolet through to the near-infrared parts of the electromagnetic spectrum. Lieber says that it will be essential to learn more about the basic physics of the nanowire lasers before they are used in real-world devices, but some simple applications could be ready in less than five years.

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