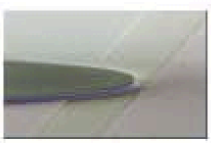
Californians build first silicon laser

http://optics.org/article/20688

29 Oct 2004

Scientists demonstrate a silicon waveguide laser that relies on the Raman effect.

After years of frustration and failed attempts, scientists have finally found a way to make silicon lase. The breakthrough is important because it paves the way for integrating lasers and electronics together on the same silicon chip. Currently, the two are made separately, as today's semiconductor lasers are based on materials such as GaN and GaAs.



next step

Now researchers from University of California at Los Angeles, US have brought the dream of unification one stage closer by constructing the world's first silicon laser (*Optics Express* **12** 21). The prototype device emits picosecond pulses in the near infrared (1.68 µm).

Their success hinges on taking a different approach to others in the field. While other researchers have obtained light emission (but not lasing) from silicon by either doping it with erbium or riddling it with tiny holes, Ozdal Boyraz and Bahram Jalali decided to investigate the possibility of using the Raman effect.

"Our approach is fundamentally different," Jalali told Optics.org. "The advantage is that is that we don't need special impurities or nanostructures so the technology is

100% compatible with silicon chip manufacturing."

The Raman effect, which uses vibrations within a material to create optical gain, is often used in long lengths of silica glass fibres in the communications sector to amplify data signals. As the effect is 10,000 times stronger in silicon Jalali realized that it should be possible to obtain sufficient gain for lasing in a silicon waveguide that is just a few centimetres long.

He and Boyraz made such a 2 cm silicon waveguide, placed it inside a fiber loop cavity and then pumped it with 30 ps pulses at 1540 nm from an amplified mode-locked laser. At a peak pump power of 9 W the fiber cavity started to lase at 1675 nm. The laser had a slope efficiency of 8.5% and emitted 25 ps pulses.

The team is now working on a version that operates in continuous wave (CW) mode and is thinking of commercialising the design. As for potential applications, the tunable nature of Raman effect means that it could be possible to make silicon lasers that operate in the mid-infrared. Sources in this region are required by the defense sector for detection of biochemicals and infrared countermeasures as well as free-space optical communication through fog.

"One limitation of our approach is that the laser is optical pumped so it should not be viewed as a replacement for laser diodes, which are electrically pumped," said Jalali. "The silicon Raman laser should be viewed as a device that will extend the wavelength range of those lasers to regions where they cannot operate."

Author
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