Room-Temperature Microlasers

Duncan Graham-Rowe, Technology Review – Published MIT

Scientists have created the smallest ever laser capable of operating at room temperature. The device is less than one cubic micron--less than the wavelength of the light it emits. It is the first sub-wavelength laser that doesn't require cryogenic cooling.

Yeshaiahu Fainman, head of the Ultrafast and Nanoscale Optics Group at the University of California, San Diego, who led the work, says it should be possible to pack the microlasers close together without interference between devices. This paves the way for, among other things, faster optical communications devices that use sub-wavelength lasers in dense arrays.

The researchers modified what's known as a microdisc laser. In this type of laser, a microscopic disc containing different materials is optically pumped by a larger laser. This stimulates its semiconductor core to emit light, which bounces around the disc's edges before being released. Adding metal to this disc can prevent the laser from behaving in a way that would interfere with other devices in close proximity. But this reduces the laser's efficiency, and until now the only way to counteract this loss in performance has been to cool it cryogenically to around 77 degrees Kelvin (-196 degrees Celsius) using liquid nitrogen, which is far from practical.

Fainman, together with postdoc Maziar Nezhad and other UCSD colleagues, found a simpler way to improve the efficiency of their laser, and to remove the need for cooling. They added a layer of silica, followed by a layer of aluminum around a laser cavity made of indium gallium arsenide phosphide. The outer metal layer acts like a shield, isolating the laser from other devices, and acting like a highly efficient heat sink. The silica layer prevents the metal from reducing the lasers's overall efficiency.

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