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Microdisk laser creates tiny sensor

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Gas detection is just one application of a microdisk laser made on a silicon wafer.

Researchers at Northwestern University in the US have developed an ultraviolet microdisk laser based on a silicon substrate. With diameters varying between 2 and 20 microns, the team says its tiny disk laser could find uses in anything from chemical sensing to data storage. (*Applied Physics Letters* **84** 2488)

Microdisk laser

Although significant progress has been made recently in developing efficient silicon emitters, a silicon laser remains elusive. Instead of trying to produce optical gain in silicon directly, Hui Cao and his colleagues decided to grow a gain material on top of a silicon substrate.

The approach involves fabricating silicon dioxide (SiO2) microdisks which sit on a silicon pedestal etched from a commercial silicon wafer. A layer of zinc oxide (ZnO), approximately 55 nm thick, is then deposited onto each disc and acts as a gain medium.

The researchers pump the SiO2disk with 355 nm, 20 ps pulses from a mode-locked Nd:YAG laser. This sets up whispering gallery (WG) modes in the discs, which act as lasing modes.

Now that they have demonstrated lasing in their hybrid SiO2/ZnO microdisk system, Cao and colleagues are trying to improve the laser's output. "We are trying to make deformed disks to obtain directional output," he told Optics.org. "We are also trying to fabricate a waveguide very close to the microdisk so that the laser light can be coupled into the waveguide."

The first application the laser has found is as a chemical sensor. "We measured the lasing frequency shift when chemical vapour (e.g. nitrobenzene, tolune) is introduced to the microdisk," said Cao. "Since the lasing peak is very narrow, we can detect tiny frequency shifts due to the absorption of molecules on the disk."

Author
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