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Photonic-crystal surface-emitting laser chip performs variety of configurations with modulation **FREE**

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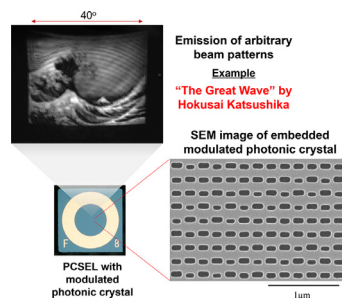
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Device demonstrates path forward for improved LIDAR systems that don't require external optics by producing multidot, beam scanning and flash patterns.



Autonomous driving and face recognition for personal devices have boosted the demand for light sources that allow for non-mechanical 2D beam scanning and emitting light in arbitrary patterns, called “structured light.” Photonic-crystal surface-emitting lasers (PCSELS) show promise for such applications due to their ability to produce high-quality beams without requiring bulky lenses and mirrors.

Researchers have demonstrated a laser chip using PCSEL technology with modulated photonic crystals. With a design based on an inverse Fourier transform, the photonic crystals developed by Sakata et al. enable a wide variety of light sources, including beam scanning, flash, and multidot configurations.

The new type of laser provides a path forward for advanced object recognition and adaptive illumination with more straightforward designs.

“Until now, beam scanning and the emission of arbitrarily patterned light beams have been achieved using external elements in addition to laser light sources, such as lenses, mirrors, and motors, and also by using diffractive optical elements, which make the overall system large and complicated,” said author Susumu Noda. “On the other hand, in our work, we have developed a laser with which these functionalities are achieved using no such external elements whatsoever.”

The semiconductor chip achieves this performance by arranging the nanoscale air holes that occur in the photonic crystal layer into a periodicity on the order of the wavelength of light in the material and modifying their sizes and positions. This provides the large-area resonance and surface emission of arbitrary beam patterns that define the features of PCSELS.

Noda said the researchers are gearing up for the implementation of their laser chips into real-world autonomous driving and face recognition applications.

Source: “Photonic-crystal surface-emitting lasers with modulated photonic crystals enabling 2D beam scanning and various beam pattern emission,” by Ryoichi Sakata, Kenji Ishizaki, Menaka De Zoysa, Kyoko Kitamura, Takuya Inoue, John Gellera, and Susumu Noda, *Applied Physics Letters* (2023). The article can be accessed at <https://doi.org/10.1063/5.0127495>.

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