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DEEP INSIGHTS FOR THE TECH INDUSTRY

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Measuring lithography plasma sources; hexagonal boron nitride for heat; mode-division multiplexing.

Measuring lithography plasma sources

Researchers from the University of Twente developed a tool that can measure the size of a plasma source and the color of the light it emits simultaneously, which they say could be used to improve lithography machines.

"Traditionally, we could only look at the amount of light produced, but to further improve the chipmaking process, we also want to study the colors of that light and the size of its source," said Muharrem Bayraktar, assistant professor at the XUV Optics Group at Twente's MESA+ Institute for Nanotechnology.

The tool uses a combination of tapered zone plates and transmission grating. Tapered zone plates are specialized optical components that manipulate extreme ultraviolet light to precisely image the plasma source. The transmission grating disperses the light into its individual colors, making it possible to individually measure them.

"We want to make the plasma as small as possible. Too large and you 'waste' a lot of light because the mirrors cannot catch all the light," added Bayraktar, noting that also the emitted color is important. "The plasma does not only emit extreme ultraviolet light, but also other colors." The tool enables researchers to investigate the relation between the size of a plasma source and the color of the light it emits.

Yahia Mostafa, Zoi Bouza, James Byers, Ievgeniia Babenko, Wim Ubachs, Oscar O. Versolato, and Muharrem Bayraktar, "Extreme ultraviolet broadband imaging spectrometer using dispersion-matched zone plates," Opt. Lett. 48, 4316-4319 (2023) https://doi.org/10.1364/OL.496995

Hexagonal boron nitride for heat

Researchers from Nanyang Technological University Singapore suggest using hexagonal boron nitride (BN) to aid in heat dissipation in 3D stacked electronics.

The team first coated particles of BN with iron oxide to make them responsive to magnetic fields. They then suspended the coated particles in a solvent and used a magnetic field to align the particles in different orientations.

The scientists tested the ability of the different configurations to dissipate heat and found that vertically arranged particles channeled heat upwards most effectively. The orientation of the particles could also be tailored to direct heat sideways, such as when the particles are sandwiched between two heat-emitting electronic components.

"Our method of aligning and orienting BN particles precisely and easily to strategically direct heat away could offer new solutions for effective heat management of high-power electronic devices," said Hortense Le Ferrand, an assistant professor in NTU's School of Mechanical and Aerospace Engineering.

He, H., Peng, W., Liu, J., Chan, X. Y., Liu, S., Lu, L., Le Ferrand, H., Microstructured BN Composites with Internally Designed High Thermal Conductivity Paths for 3D Electronic Packaging. Adv. Mater. 2022, 34, 2205120. https://doi.org/10.1002/adma.202205120

Mode-division multiplexing

Researchers from Shanghai Jiao Tong University, Nokia Bell Labs, and Shanghai University developed a light-mode coupler for mode-division multiplexing (MDM) in optical interconnects.

The structure can manipulate a specific light mode traveling in a nearby bus waveguide, such as a nanowire carrying the total multi-mode signal. The coupler can inject a desired light mode into the bus waveguide or extract one from it, sending it towards a different path.

The devices uses a gradient-index metamaterial (GIM) waveguide with a refractive index that varied continuously along the direction of propagation of light, enabling a seamless and efficient transition of individual light modes to and from the nanowire bus by mitigating the parameter variations of the waveguides.

By cascading multiple couplers, the researchers created a 16-channel MDM communication system that supported 16 different light modes—TE0 to TE15—simultaneously. In a data transmission experiment, it achieved a data transfer rate of 2.162 Tbit/s, which they say is the highest reported value for an on-chip device operating at a single wavelength.

The device was fabricated using methods compatible with semiconductor device manufacturing.

Yu He, Xingfeng Li, Yong Zhang, Shaohua An, Hongwei Wang, Zhen Wang, Haoshuo Chen, Yetian Huang, Hanzi Huang, Nicolas K. Fontaine, Roland Ryf, Yuhan Du, Lu Sun, Xingchen Ji, Xuhan Guo, Yingxiong Song, Qianwu Zhang, and Yikai Su "On-chip metamaterial-enabled high-order mode-division multiplexing," Advanced Photonics 5(5), 056008 (13 September 2023). https://doi.org/10.1117/1.AP.5.5.056008

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