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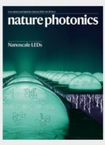

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Nanoscale LEDs

An artistic image of an array of nanoscale organic LEDs (nano-OLEDs) fabricated by self-aligned nanostencil etching and lithography. The resulting light emitters have a pixel size as small as 100 nm, pixel densities of up to 100,000 pixels per inch and an average external quantum efficiency of 13.1%.

See Marcato et al

Image: Ms. Amanda Paganini. Cover design: Bethany Vukomanovic

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Electron shaping for continuous terahertz coverage

Modulating an electron beam with a frequency-beating laser enables a free-electron laser to generate high-power, narrowband terahertz pulses that can be continuously tuned from 7.8 to 30.8 terahertz.

Keigo Kawase & Goro Isoyama

News & Views
06 Jan 2026

Multiplying matrices in a single pass with light

Optical computing has been limited to vector–matrix multiplications, with matrix–matrix operations requiring wavelength- or time-division multiplexing, reducing energy efficiency and speed. Now, researchers have demonstrated a free-space optical approach that overcomes these limitations, enabling parallel matrix–matrix and tensor–matrix multiplications in a single optical operation.

Carlos A. Ríos Ocampo & Nathan Youngblood

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Electrically controlled nano-OLED metasurfaces

A nanostencil lithography technique enables fabricating arrays of green-emitting OLEDs with pixels as small as 100 nm and an external quantum efficiency of 13.1%.

Jung-El Ryu & Jeehwan Kim

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Expanded infrared sensitivity

Anastasia Vasylchenkova

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Photonics looks deeper into biology

From super-resolution endoscopes to multi-photon microscopes, photonic technologies are being translated from laboratory innovations to tools for clinical diagnosis and biological inquiry.

Giampaolo Pitruzzello

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Review Articles

Review Article
06 Jan 2026

Interlayer engineering in metal halide perovskite photovoltaics

This Review discusses recent advances in interlayer engineering for perovskite solar cells, highlighting promising materials and architectures that could improve the stability and efficiency of devices.

Seong Sik Shin, Byung-wook Park ... Sang Il Seok

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Articles

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Plasmon-enhanced ultralow-threshold solid-state triplet fusion upconversion

Performance of solid-state triplet fusion upconversion films is enhanced by surface plasmons, intensity threshold is reduced by a factor of 17 and external quantum efficiency is enhanced by a factor of 19. A white-emitting organic light-emitting diode featuring upconverted blue emission—rather than blue electroluminescence—is demonstrated, with a colour rendering index of up to 86.2.

Jesse A. Wisch, Kelvin A. Green ... Barry P. Rand

Article
Open Access
31 Oct 2025

Scalable nanopatterning of organic light-emitting diodes beyond the diffraction limit

Nanostencil etching and lithography enable the fabrication of green-emitting nanoscale organic light-emitting diode pixels with size as small as 100 nm, densities as high as 100,000 pixels per inch and average external quantum efficiency of 13.1% for green emission.

Tommaso Marcato, Jiwoo Oh ... Chih-Jen Shih

Article
20 Oct 2025

Perovskite crystallization control via an engineered self-assembled monolayer in perovskite–silicon tandem solar cells

An engineered self-assembled monolayer improves perovskite crystallization, enabling perovskite–silicon tandem solar cells with a certified power conversion efficiency of 33.59%. 90% of which is maintained after 2,000 h of operation at ambient temperature.

Daoyong Zhang, Boning Yan ... Xuegong Yu

Article
12 Nov 2025

On-site enhancement and control of spin-forbidden dark excitons in a plasmonic heterostructure

Observation and control of spin-forbidden dark excitons is demonstrated in a hybrid heterostructure of WSe_2 monolayers and plasmonic nanocavities.

Jiamin Quan, Michele Cotrufo ... Andrea Alù

Article
Open Access
07 Nov 2025

Stabilizing high-efficiency perovskite solar cells via strategic interfacial contact engineering

Engineering the perovskite–electrical contact interface with sodium heptafluorobutyrate reduces interfacial defects and improves charge transport in perovskite solar cells. Functionalized devices deliver a certified power conversion efficiency of 26.96%, which is fully retained after 1,200 h of continuous operation under 1-sun illumination.

Guixiang Li, Zuhong Zhang ... Antonio Abate

Article
09 Dec 2025

Light-based catalyst-free conversion of CH_4 and CO_2

Catalyst-free conversion of methane and carbon dioxide using light of various wavelengths under ambient conditions is reported.

Jianxin Zhai, Ruo-Ya Wang ... Buxing Han

Article
Open Access
03 Nov 2025

Frequency-stable nanophotonic microcavities via integrated thermometry

Integrating a thin-film resistance thermometer above a high-Q SiN microresonator enables local temperature monitoring and active stabilization of its resonance wavelength. The emission wavelength of a distributed feedback laser locked to the microresonator fluctuates within 0.5 pm over a period of 50 h.

Sai Kanth Dacha, Yun Zhao ... Alexander L. Gaeta

Article
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13 Nov 2025

Self-compressed waveform-stable light transients enabling water-window attosecond spectroscopy

Researchers demonstrate phase-stable sub-cycle self-compressed light transients, as well as their sampling down to half of an optical cycle, and determine their waveform phase offset. They apply the transients to soft X-ray high-harmonic generation and attosecond X-ray absorption spectroscopy.

Valentina Utrio Lanfaloni, Federico Vismarra ... Hans Jakob Wörner

Article
04 Nov 2025

Quantum fusion of independent networks based on multi-user entanglement swapping

The quantum fusion of two independent 10-user networks is demonstrated based on multi-user entanglement swapping. Active temporal and wavelength multiplexing schemes are developed to merge the two networks into a larger network with 18 users in the quantum correlation layer.

Yiwen Huang, Yilin Yang ... Xianfeng Chen

Article
20 Oct 2025

Continuous terahertz band coverage through precise electron-beam tailoring in free-electron lasers

High-power, tunable accelerator-based terahertz radiation is demonstrated. By electron-beam manipulation through laser heater beating, tunable capability from 7.8 to 30.8 THz, narrow spectral bandwidths (ranging from 7.7% to 14.7%) and pulse energies up to 385 μJ are obtained.

Yin Kang, Tong Li ... Zhentang Zhao

Article
Open Access
14 Nov 2025

Direct tensor processing with coherent light

The researchers demonstrate parallel optical matrix–matrix multiplication, which enables fully parallel tensor processing through a single coherent light propagation. The approach provides a scalable, high-efficiency foundation for advancing next-generation optical computing.

Yufeng Zhang, Xiaobing Liu ... Xuhan Guo

Article
10 Nov 2025

Exciton management and balanced charge-carrier transport enable efficient organic field-effect light-emitting transistors

Red, green and blue organic field-effect light-emitting transistors in which charge-carrier transport and light emission are spatially separated to improve exciton management and device efficiency are reported.

Donghai Li, Yuchen Hou ... Wei Huang

Article
24 Nov 2025

In situ dynamic regulation of strain at the buried interface of stable perovskite solar cells

The additive molecule DHHB enables UV shielding, chemical passivation and strain regulation at the buried interface of perovskite solar cells. Small-area devices achieve a power conversion efficiency of 26.47%, 96% of which is maintained after 1,132 h of continuous operation.

Jiakang Zhang, Wenjian Yan ... Zhongmin Zhou

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