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OPTICAL PHYSICS

Miniaturizing spectrometers to nanoscale

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Optical spectrometers have been playing significant roles in our life since Sir Isaac Newton demonstrated in 1666. Up to now, they still majorly rely on the dispersion of light by prisms or gratings in free space. For *in-situ* measurements, it was a wide dream to miniaturize these spectrometers while keeping their resolution and spectral range.

Recently, researchers from the Cambridge Graphene Centre at the University of Cambridge have reported an ultracompact optical spectrometer with a size down to nanoscale. They use a bandgap graded semiconductor nanowire as the active material and fabricate a series of parallel photodetectors along its length. The bandgap gradient enables the photodetectors to selectively detect the wavelengths. A target spectrum is computationally reconstructed by cross-referencing the measured set of photocurrents and response functions of each of these photodetectors. Therefore, the light dispersion and detection are conducted simultaneously in a single nanowire. Despite the simplicity in design, this nanowire spectrometer is capable of accurate monochromatic and broadband light reconstruction. This further enables macro and micro spectral imaging. This work not only opens new opportunities in *in-situ* spectroscopy, but also provides a new conceptual platform for rich light-matter interactions based on compound materials and semiconductors.

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OPTOELECTRONIC DEVICE

Mid-infrared lasers on silicon operating close to room temperature

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Mid-infrared (MIR) wavelength is strategical important band for thermal imaging, remote sensing, free space communication, etc. Recent progresses in integrated mid-infrared photonics on silicon offer an alternative platform for manufacturing low-cost and high-performance MIR system in high volumes. However, light source has always been a grand challenge for integrated photonics and it is even harder to monolithically integrate MIR laser on silicon which could be operated at room temperature.

A multi-institutional team of researchers, led by Prof. Shui-Qing Yu from University of Arkansas, have recently made significant improvement to optically pumped MIR lasers, which is made of GeSn monolithically integrated on silicon substrates, capable of covering lasing wavelength from 2 to 3 μm. The researchers could obtain high-quality direct bandgap GeSn alloy with 20% Sn composition, allowing a low lasing threshold and relatively high operation temperature being close to the room temperature. This process is CMOS compatible and can be easily monolithically integrated onto current silicon platform for low-cost, lightweight, compact, low-power consuming integrated mid-IR light sources.

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