

New Polariton Technology Could Revolutionize Thin Infrared Detectors in Various Industries

TURKU, FINLAND, November 6, 2025 /EINPresswire.com/ -- Researchers at the [University of Turku](#), Finland, have developed a groundbreaking organic infrared photodiode that achieves record-level sensitivity in devices that are ultrathin and ready to be integrated into different applications. This infrared photodiode could pave the way for compact, low-power sensors for medical, environmental and wearable technologies.

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Infrared detection is the process of sensing thermal radiation, or invisible infrared light. All objects and living organisms emit heat that can be measured and converted into an image or electrical signal. Infrared detectors are used in various applications, such as medical imaging, environmental monitoring systems, and machine vision.

Most infrared detectors are based on inorganic materials. They typically perform better, but are more expensive and

complicated to fabricate than organic carbon-based solutions. Organic detectors are a promising alternative as they are not only cheaper, but also lightweight, easily tunable, and can be integrated with other materials. However, most current designs still depend on thick films or external filters that add bulk and cause the detected color to drift when light arrives from different directions. This limits the precision and applicability of the carbon-based devices, especially in thin, portable systems.

In a recent study, researchers from the University of Turku in Finland addressed this challenge by developing new, thinner and more efficient technologies powered by polaritons, hybrid light-matter states formed inside an optical microcavity.

The researchers engineered strong exciton-photon coupling so that the resulting polariton mode has a flattened dispersion, preserving color selectivity across wide viewing angles while keeping the active layer exceptionally thin.

They realized this using a non-fullerene acceptor blended with an active material to establish a clean morphology and efficient charge transport within a compact Fabry-Pérot architecture, validated by angle-resolved optical and electrical measurements and coupled-oscillator analysis. The device exhibits an exceptionally narrow detection band and maintains high responsivity

without separate filters, while its response is ultrafast and its measured detectivity is competitive with leading organic approaches, together setting a new benchmark for narrowband organic infrared photodiodes.

“We demonstrate that polaritonic engineering is not only a concept from fundamental physics but also a practical pathway to solve real device challenges, such as angular color stability and sensitivity in a truly thin architecture,” says lead author Ahmed Gaber Abdelmagid from the University of Turku.

“By tailoring light-matter interaction inside the cavity, we unlock narrowband infrared detection that fits the needs of compact and wearable systems on a robust polariton platform,” adds senior author Konstantinos Daskalakis.

Beyond this single result, the innovation has broader implications for applications: by molecularly tuning non-fullerene acceptors, the same polaritonic approach can be extended from the visible into the infrared. This would enable lightweight, low-power sensors for phones and wearables, compact spectrometers for point-of-care diagnostics, and energy-efficient modules for autonomous platforms, and without the penalties of bulky filters or thick absorbers.

The research article was published as the Editor’s Choice article in [Advanced Optical Materials](#).

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