



Quantum dots offer an affordable alternative to infrared light sources

Researchers at ICFO have developed a new source of shortwave infrared (SWIR) light based on quantum dots that is powerful, efficient, stable, and cost-effective. Reported in *ACS Photonics*, the approach overcomes the longstanding trade-off between high performance and affordability that has limited previous SWIR devices, opening the door to next-generation machine vision technologies. As a proof of concept, the team has already demonstrated its potential for industrial inspection, food safety monitoring, surveillance, and biomedical diagnostics.

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Imaging through smoke and fog, at night, from a remote location, keeping the eyes safe... These desirable features for next-generation machine vision technologies could all be enabled by **shortwave infrared (SWIR) light**. However, conventional SWIR-emitting technologies face significant challenges and do not yet offer a viable alternative that simultaneously achieves high power, high efficiency, and low cost.

For the past few years, the [Functional Optoelectronic Nanomaterials](#) group at ICFO has been looking for cost-effective alternatives based on quantum dots -tiny semiconductors that behave like individual atoms- that don't sacrifice efficiency. In a recent publication in ACS Photonics, **Aditya Jagadeesh Malla, Dr. Katerina Nikolaidou, Miguel Dosil, Dr. Mariona Dalmases, Dr. Stephy Vincent, and Marta Martos Valverde**, led by **ICREA Prof. Gerasimos Konstantatos**, have demonstrated that **lead sulfide quantum dots can indeed give rise to high-power, efficient, and stable downconverters** (devices that absorb higher-frequency photons and convert them to lower-frequency ones, in this case, within the SWIR range). To achieve their goal, the researchers took advantage of a defining property of quantum dots, namely, that the larger the dots, the lower the frequency of the photons they emit and absorb. Thus, the team employed smaller dots to absorb high-frequency light and mixed them with bigger ones that emitted in the SWIR range. By simply varying the size of the emitting dots, they could cover a significant part of the SWIR region, creating a **highly tunable downconverter**.

The team, however, had to face the quantum dots main drawback: significant heat generation after light absorption. Overcoming this limitation required an innovative device architecture. *“We dispersed the quantum dots in a polymer that was then sandwiched between two different substrates (a DBR and a sapphire substrate),”* explains first author Aditya Jagadeesh. The result was a **emission power density** of 385 mW/cm² at a SWIR wavelength of 1380 nm, a significant milestone that sets a new record for infrared quantum dot light emitters. Aditya puts it in perspective: *“At the moment, there are only a few pricey SWIR light sources available. Our study, conversely, demonstrates that high-power outputs possible at an affordable cost.”*

“Several applications could benefit from these novel devices. In the study, the researchers already showcased their potential for night vision and vision under adverse weather conditions” **automotive use or fire-fighting**, seeing through certain plastics and silicon wafers for **industrial quality control**, eye-safe imaging for **facial recognition**, moisture detection for **agriculture and the food industry**, and under-tissue visualization for **biomedical imaging**.

“With the arrival of low-cost SWIR image sensors based on colloidal quantum dots, we anticipated that the next thing to address was the supply of a low-cost light source that can be manufactured at scale,” says Prof. Gerasimos Konstantatos, lead researcher of the study. *“With this work,”* he adds, *“we are confident that colloidal quantum dot can also bridge the gap between affordability and performance in SWIR sources.”*

Reference:

Aditya Jagadeesh Malla, Katerina Nikolaidou, Miguel Dosil, Mariona Dalmases, Stephy Vincent, Marta Martos Valverde, and Gerasimos Konstantatos, High Power, Efficient, and Stable Quantum Dot-Based Downconverters for SWIR Applications, ACS Photonics **2026** 13

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