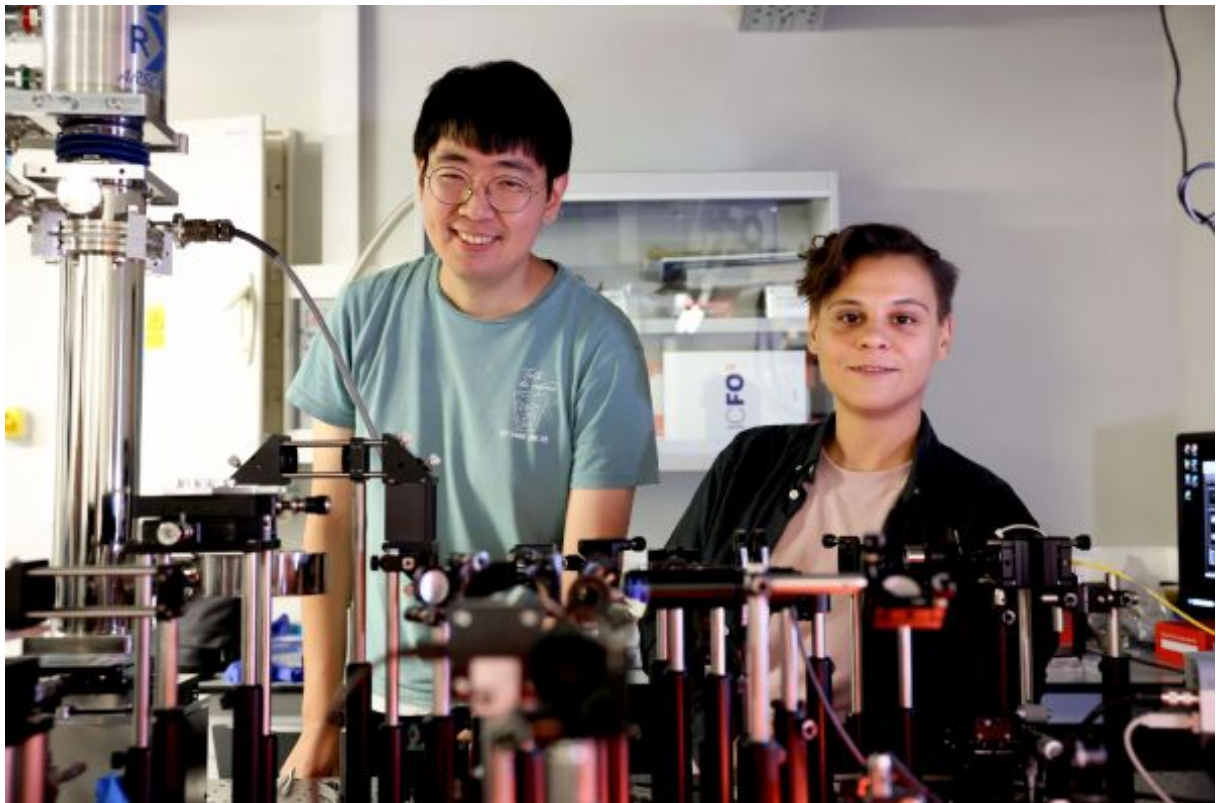




Controlling shell growth on quantum dots yields more efficient SWIR LEDs

ICFO researchers have achieved a record light-emission efficiency for SWIR quantum dots by understanding and controlling how a shell grows around the dot's core. In a study published in *Nature Communications*, they have used these dots to build LEDs, which set a new state of the art for heavy-metal-free SWIR devices.

October 19, 2026

Short-wave infrared (SWIR) light-emitting diodes ([LEDs](#)), which emit at wavelengths of roughly 1,000-2,500 nm, could unlock applications that are beyond the reach of conventional visible or near-infrared LEDs, including machine vision, biological imaging and optical communication. Indium Arsenide (InAs) [quantum dots](#) have recently emerged as promising SWIR light sources, mainly because they are free of heavy metals, which makes them environmentally friendly, and solution-processable, which simplifies device fabrication. Nevertheless, the light emission of quantum dots can become weak, mainly because their surface is prone to defects. Another material is thus grown around the core as a shell. This, however, introduces another challenge: because the core and the shell are typically made of

different materials, whose atoms are not equally spaced, strain builds up at the interface. Eventually, this also gives rise to defects that reduce the photoluminescence quantum yield (PLQY), a measure of how efficiently a material emits light.

Scientists are seeking ways to increment this factor as much as possible, and ICFO researchers, including **Dr. Taewan Kim, Dr. Manuela De Franco, Dr. Miguel Dosil, Dr. Jae Taek Oh, Dr. Rajesh Bera, Marta Martos Valverde, and Dr. Gaurav Kumar**, led by **ICREA Prof. Gerasimos Konstantatos**, have now proposed a new approach. By understanding how a shell made of zinc selenide (ZnSe) grows on InAs quantum dots and carefully controlling that process, they have **greatly improved the dots' light-emission efficiency**. The team has reported, in a study published in Nature Communications, a **PLQY above 55%**, surpassing the PLQY typically reported for comparable systems, and has used these quantum dots to make state-of-the-art InAs-based SWIR LEDs. ?

To synthesize the dots, the researchers first prepared InAs cores and treated them with zinc chloride (ZnCl₂). This treatment slightly etched the core surface, releasing some individual I and As atoms that then could participate in the ZnSe shell growth. As a result, the interface between the core and the shell was formed more gradually, which mitigated strain and promoted shell growth. i.e. Previous studies have mainly focused on the final shell structure. Our work, in contrast, shows that **the very early stage of shell growth is also critical**, i.e. as Dr. Taewan Kim, first author of the article

. The team also introduced a small amount of oxidation at the InAs surface. This oxidized interface helped to reduce the strain that develops as the ZnSe shell grows thicker. i.e. Oxidation is usually considered harmful to quantum dots because it can create defects and reduce light emission, i.e. explains Kim. i.e. But, in this case, **small and controlled amount of oxidation was actually beneficial**. i.e.

? Finally, the researchers built LEDs using the InAs/ZnSe quantum dots as the light-emitting layer. The devices simultaneously achieved long-wavelength emission, high efficiency, high radiance, and operational stability, setting **a new state of the art for heavy-metal-free SWIR LEDs based on quantum dots**. i.e. Achieving high photoluminescence efficiency was only part of the challenge. We also needed to translate these properties into a working device, where charge injection and transport become equally important," says Dr. Manuela De Franco, who led the device work

. Combined with emission around 1.5 micrometres, in the telecommunications wavelength range, these results open interesting opportunities for heavy-metal-free SWIR optoelectronics and offer **a clearer picture of how the core/shell interface controls the dots' final performance**.

Reference:

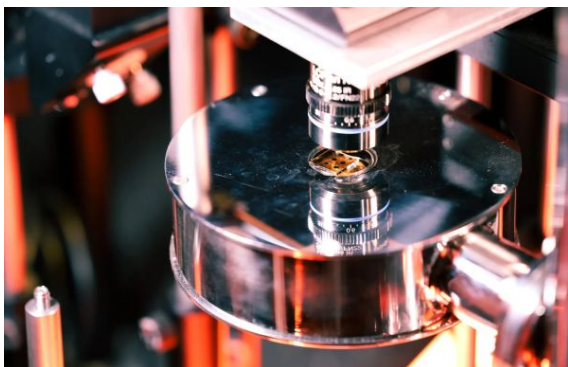
Kim, T., De Franco, M., Dosil, M. et al. Controlling the shell growth mechanism and interfacial oxidation of InAs/ZnSe quantum dots for shortwave infrared emission. Nat Commun **17**, 9969

(2026).

DOI: <https://doi.org/10.1038/s41467-026-77896-0>

Acknowledgements:

G.K. discloses support for the research of this work from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme [grant agreement no. 101002306], Project PID2024-161119OB-I00 funded by MICIU/AEI/10.13039/501100011033/FEDER, UE, MCIN with funding from the European Union NextGenerationEU (PRTR-C17.I1), and the Generalitat de Catalunya. Support was also provided by the Fundacio Privada Cellex, the CERCA programme, and the 'Severo Ochoa' Centre of Excellence [CEX2024-001490-S; MICIU/AEI/10.13039/501100011033]. T.K. discloses support for the research of this work from the Basic Science Research Program through the National Research Foundation of Korea, funded by the Ministry of Education [RS-2024-00413533]. M.D.F. discloses support for the research of this work from MICIU/AEI/10.13039/501100011033 [JDC2024-053091-I] and FSE+ (Fondo Social Europeo Plus). R.B. discloses support for the research of this work from the European Union's Horizon research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 101151468. M.M.V. discloses support for the research of this work from the European Union's Horizon research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 101081441.



Close-up picture of the device. Credit: ICFO.