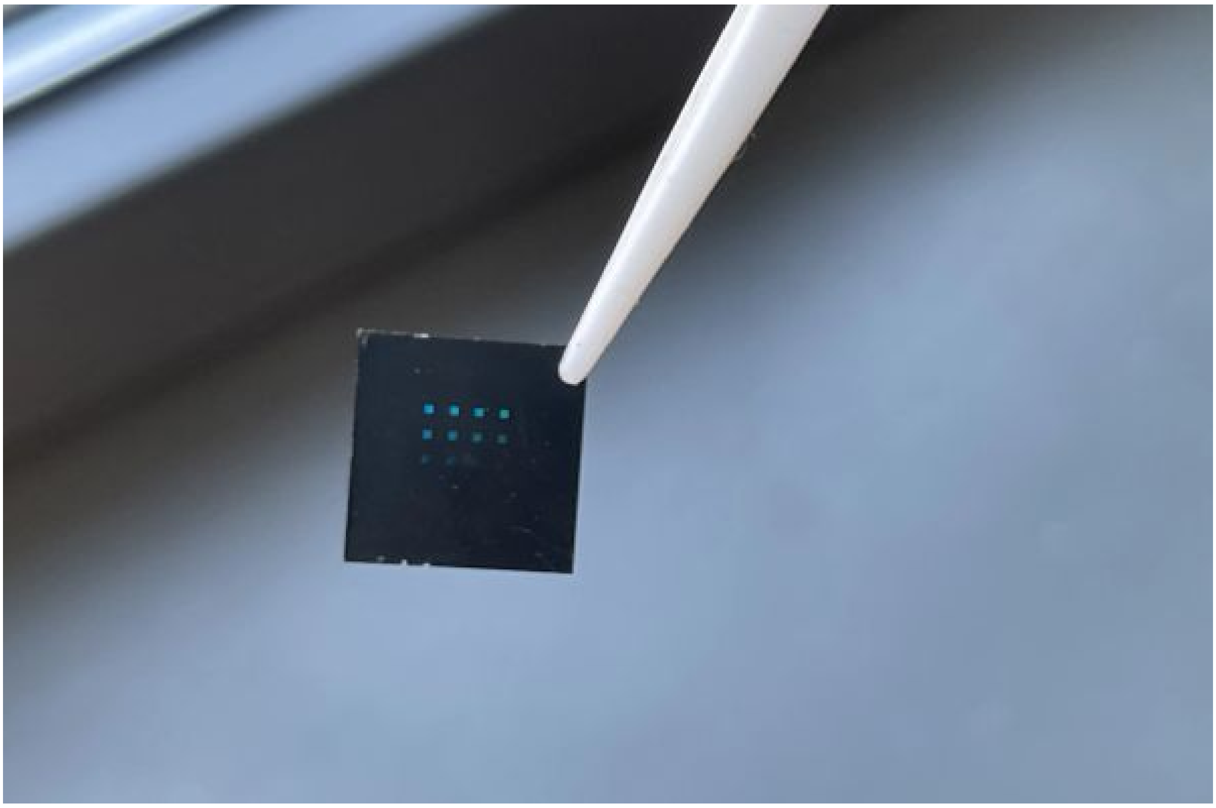

Integrating infrared lasers onto silicon for future photonic chips

ICFO researchers have developed a method to integrate infrared laser sources directly onto a silicon platform, an essential step toward realizing fully photonic integrated circuits on silicon chips. The method, presented in Advanced Optical Materials, uses solution-processed colloidal quantum dots to emit light of a very specific wavelength, which can be tuned over a broad range (from 1580 to 1680 nanometres).

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In today's era of rapid digitalization, the demand for photonic integrated circuits (PICs), which use photons instead of electrons to process information, is increasing significantly, driven by their promising applications in sensing, telecommunications, and environmental care. But PICs are still under active development, and several key challenges remain. A major one is the integration of infrared light sources onto silicon, the primary material used in photonic chips. This step is typically hindered by incompatibilities between silicon and conventional laser materials, limiting device miniaturization and large-scale manufacturing.

Now, ICFO researchers, **Hamed Dehghanpour Baruj**, **Dr. Guy L. Whitworth**, **Dr. Nima Taghipour**, **Dr. Mariona Dalmases**, **Dr. Debranjan Mandal**, led by **ICREA Prof. Gerasimos Konstantatos**, have demonstrated a way to **integrate infrared laser sources directly onto a silicon platform**. The study, published in Advanced Optical Materials, overcomes this longstanding obstacle **by employing solution-processed colloidal quantum dots (CQDs)** as light-emitters. The resulting light has **a very specific, narrow wavelength that can be tuned across a broad spectral window (1580-1680 nm)**, covering key telecommunication bands.
ï¿½Traditionally, it has been very hard to grow light-emitting materials directly on silic
n because their crystal structures don't match, which creates defects that eventually ruin t
e laser,ï¿½ explains Hamed Dehghanpour Baruj, first author of the arti
le. ï¿½Solution-processed CQDs are essentially a liquid ?ink' that can be deposited onto
lmost any surface, including silicon, without suffering from these crystal problems,ï¿½
e adds. To further enhance and control light emission, the researchers introduced a layer made of titanium dioxide (TiO_2) between the silicon substrate and the CQD film, which was patterned periodically, forming a grating. This grating acted as a series of distributed mirrors, which selectively reflect a specific wavelength of light back and forth, giving rise to what is known as a distributed feedback (DFB) laser.
ï¿½In our specific design, the pattern is engineered so that the **light exits from the edge of the device, making it much easier to connect to other components on a flat chip**,ï¿½ sa
s Dehghanpour. ï¿½To the best of our knowledge, this is the **first demonstration** of an edge-emitting DFB laser based on solution-processed CQDs integrated directly onto a silicon platform.ï¿
? This structural design is inherently generalizable, as it can be extended to other types
f CQDs, potentially enabling laser emission across a broader spectral range. The technolo
y could thus go beyond on-chip light sources for telecommunications and silicon photonic
, paving the way for integrated sensors for biomedical detection or environmental monitori
g as wel

Reference:
H. D. Baruj, G. L. Whitworth, N. Taghipour, M. Dalmases, D. Mandal, and G. Konstantatos, ï¿½Infrared Colloidal Quantum Dot Edge Emitting Lasers Integrated on Silicon.ï¿½ Advanced Optical Materials (2026): e03357.
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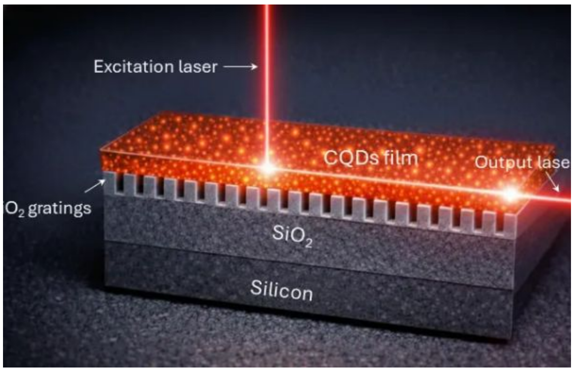

Scheme of the full device. Credit: Hamed Dehghanpour Baruj.