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Photon emission with organic molecules and nanophotonics

Chip-integrated anthracene/DBT on a photonic-crystal cavity emits on-demand indistinguishable photons into waveguides, scaling quantum computing, communications, and sensing.

Purdue researchers have created a chip-integrated single-photon source. Most current photon emitters use quantum dots or special crystals, but they produce photons randomly and are hard to scale. The Purdue device places a thin anthracene crystal seeded with dibenzoterrylene emitters on a photonic crystal cavity, forming a tightly coupled light and matter system. When the device is cooled to cryogenic temperature, an optically excited molecule releases a stream of indistinguishable photons that couple to a photonic waveguide and exit through built-in grating couplers with high efficiency. Because the photons are produced deterministically, the source circumvents the complexity of combining many probabilistic sources, increasing the scalability of photonic quantum technologies.

Technology Validation:

Operation at roughly 3K under laser pumping yielded coherent photon output that followed the cavity lineshape, confirming strong coupling and efficient out coupling through the integrated gratings.

Advantages

-On-demand generation of indistinguishable photons

-Wafer scale fabrication and pick-and-place transfer is compatible with low-loss silicon nitride photonics

-Photons can be routed to on-chip circuits or off-chip optical fibers

Applications

-Photonic quantum computing

-Quantum communication

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Category
Computing/Quantum Technologies
Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Computing/Photonic & Optical Computing Technologies

Authors
Jonathan Hood
Christian Lange

Further information
Aaron Taggart
adtaggart@prf.org

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-Entangled light generation for quantum sensing

Related Publications:

Cavity QED with molecular defects coupled to a photonic crystal cavity. https://doi.org/10.48550/arXiv.2506.01917

TRL: 4

Intellectual Property:

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