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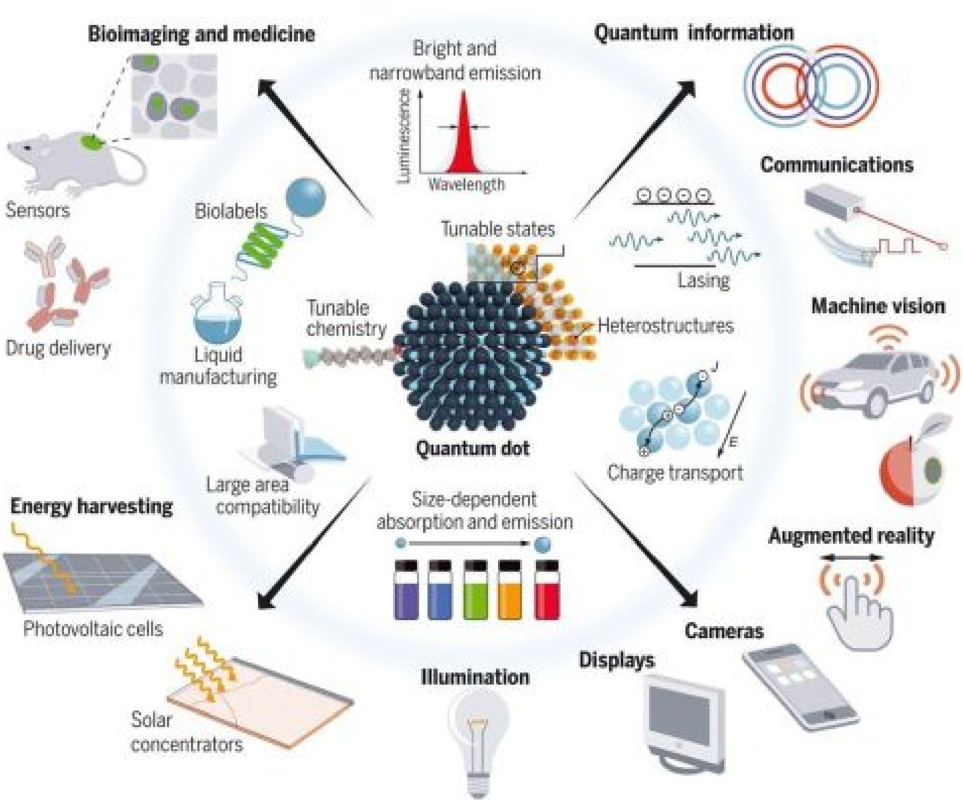

Technological advances based on semiconductor quantum dots

Review paper in Science evaluates progress to date and challenges for future developments in the field

August 06, 2021

Quantum-confined materials exhibit tunable optical, electrical, chemical and physical properties. Intensive research carried out since their discovery four decades ago has led to a deepened understanding of these materials, their properties and their manipulation, allowing them to enter the market in powerful new technologies with a wide range of applications.

In a review paper published in the journal **Science**, ICFO Group Leader Prof Pelayo Garcia de Arquer, with international leaders in the field, Prof Edward Sargent, University of Toronto; Prof Manfred Bayer, Technische Universitat Dortmund; Prof Yasuhiko Arakawa, University of Tokyo; Prof Victor I. Klimov, Los Alamos National Laboratory; and Prof Dmitri V. Talapin, University of Chicago, offer a view of the advances in the field of quantum tuned materials and their commercial utilization in an expanding list of applications.

Semiconductor quantum dots are already found in many commercial applications such as tunable lasers, displays that exhibit much purer colors compared to other alternatives, and sensors that can transduce from X-rays to long infrared wavelengths. Researchers foresee great potential for further use in a long list of applications.

Because they can be processed in liquids and at mild temperature conditions, a competitive advantage for applications that require large area devices and massive scalation, one foreseen area of growth is in solar energy harvesting. In solar cell, semiconductor quantum dots stand to augment the performance of Silicon photovoltaics, absorbing the infrared part of the solar spectrum. They are also being developed for use in luminescent solar concentrators, semitransparent aesthetic windows that absorb light and redirect it to high efficiency small PV modules at the edges of the panel, thus reducing cost.

Other applications under development include bio-lables that can be tethered to organisms and tracked using light; as photocatalystssis, acting as light absorbers that use photoexcited electrons to drive chemical reactions such as water splitting or $CO2$ recycling; and in quantum information, where they are promising as a source of quantum light to generate single photons and entangled photons.

As researchers advance in tackling issues such as toxicity and improving understanding of QD surfaces, atomic arrangement, metastable character, and device integration, the list of applications will likewise grow.