Quantum dots light up under strain

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Quantum dots

Semiconductor nanocrystals, or quantum dots, are tiny, nanometer-sized particles with the ability to absorb light and re-emit it with well-defined colors. With low-cost fabrication, long-term stability and a wide palette of colors, they have become a building blocks of the display technology, improving the image quality of TV-sets, tablets, and mobile phones. Exciting quantum dot applications are also emerging in the fields of green energy, optical sensing, and bio-imaging.

Prospects have become even more appealing after a publication, entitled "Band structure engineering via piezoelectric fields in strained anisotropic CdSe/CdS nanocrystals," was published in the journal *Nature Communications* last July. An international team, formed by scientists at the Italian Institute of Technology (Italy), the University Jaume I (Spain), the IBM research lab Zurich (Switzerland) and the University of Milano-Bicocca (Italy) demonstrated a radically new approach to manipulate the light emission of quantum dots.

The traditional operating principle of quantum dots is based on the so-called quantum confinement effect, where the particle size determines the color of the emitted light. The new strategy relies on a completely different physical mechanism; a strain induced electrical field inside the quantum dots. It is created by growing a thick shell around the dots. This way, researchers were able to compress the inner core, creating the intense internal electric field. This field now becomes the dominating factor in determining the emission properties.

The result is a new generation of quantum dots whose properties are beyond those enabled by quantum confinement alone. This not only broadens the application scope of the well-known CdSe/CdS material set but also of other materials. "Our findings add an important new degree of freedom to the development of quantum dot-based technological devices," the researchers say. "For example, the elapsed time between light absorption and emission can be extended to be more than 100 times longer compared to conventional quantum dots, which opens the way towards optical memories and smart pixel new devices. The new material could also lead to optical sensors that are highly sensitive to the electrical field in the environment on the nanometer scale."

More information: "Band structure engineering via piezoelectric fields in strained anisotropic CdSe/CdS nanocrystals" *Nat Commun*. 2015 Jul 29; 6:7905. DOI: 10.1038/ncomms8905

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