SAINTS PERSPECTIVES

Things Exceptional (Nobel Prizes)

The Nobel Prize in Chemistry 2023

4 October 2023.

The Nobel Prize Committee

Announced that the

2023 Nobel Prize in Chemistry

Is awarded jointly to

Alexei I. Ekimov, Louis E. Brus and Moungi G. Bawendi

for their work on semiconducting nanoparticles known as Quantum dots

Description

Quantum dots are extremely tiny - just a few millionths of a millimetre across. They are an artificially-created collection of semiconducting nanoparticles that glow blue, red or green when exposed to light.

Their exact size determines the colour of light they emit when given energy. The smallest quantum dots emit higher energy waves and produce blue light, and biggest dots release lower energy waves creating red light, with the middle sizes creating the colours in between.

The physics underlying quantum dots have been well-established since the 1930s. But making use of this knowledge had seemed impossible. That changed in 1979, when **Dr Alexei I. Ekimov**, then at the S.I. Vavilov State Optical Institute in St Petersburg, Russia, began the first experimental production of quantum dots. He was able to produce tiny crystals of copper chloride in glass, vary the colour of light they emitted by changing their size and prove the connection with the pre-existing theory. These experiments mean it is likely, says Olof Ramström of the Royal Institute of Technology in Sweden, that some medieval manufacturers of stained glass unknowingly got there first.

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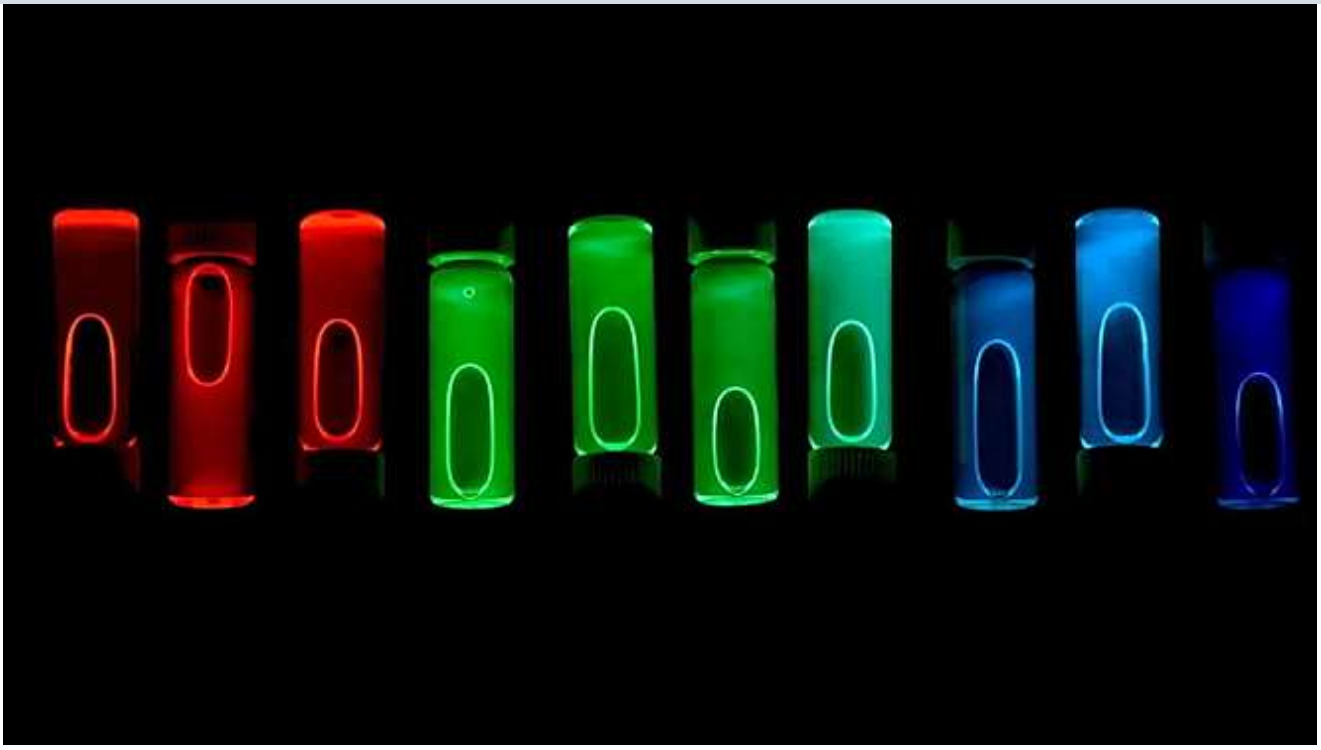

Moungi G. Bawendi pioneered the development of quantum dots that emit very pure light

As appealing as coloured glass may be, it is a difficult medium for scientists to work with. In 1983 a more tractable manufacturing method was discovered. US chemist, **Dr Loius E. Brus**, then at Bell Laboratories in New Jersey, was able to create them as free-floating particles in solution, allowing the phenomenon to be observed in liquids as well as solids.

The tiny scale at which such processes take place calls for meticulous engineering if they are ever to be harnessed commercially. It was for solving this problem that the committee awarded the final third of the prize to Paris-born **Dr Moungi G.Bawendi**, of the Massachusetts Institute of Technology. In 1993 he and his colleagues developed a technique for producing quantum dots to order. By injecting reagents into a solvent at high temperature, they were able to create small seed crystals around which bigger ones could be encouraged to form.

In the intervening decades, these tiny objects have had an outsize impact. They are used in lighting, to harness solar energy, and to tag body parts for biomedical imaging. So-called quantum-led televisions and computer monitors are

churned out by the millions, advertising crisper colours that will not fade over the life of the device.

Possible Applications

The most significant impact, however, may be on the broader field of nanoscience, which aims to exploit various sorts of quantum strangeness to accomplish useful things. It is even possible that they may be used in the architecture of future quantum computers. Although scientists have long dreamt of exploiting this domain, few thought precision engineering on such a minuscule scale would be possible. The work of this year's laureates gave much-needed hope.

Prize amount:

11 million Swedish kronor, to be shared equally between the Laureates.

About the Winners

Left to right: Dr Alexei I. Ekimov, Dr Louis E. Brus and Dr Moungi G. Bawendi

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Dr Alexei I. Ekimov Born: 1945, Former USSR
Affiliation at the time of the award: Nanocrystals Technology Inc., New York, NY, USA

Dr Loius E. Brus born 10 August 1943 in Cleveland, Ohio, United States. In 1996, Brus left Bell Labs and joined the faculty in the Department of Chemistry at Columbia University.

Dr Moungi G.Bawendi born 15 March 1961 is an American-Tunisian-French chemist. He is currently the Lester Wolfe Professor at the Massachusetts Institute of Technology.
Bawendi had worked as a postdoc with Brus, when they were in Bell Labs.

Previous Winners of the Nobel Prize in Chemistry

- **2022** - **Carolyn Bertozzi, Morten Meldal and K. Barry Sharpless**
  - "for the development of click chemistry and bioorthogonal chemistry"

- **2021** - **Benjamin List and David W.C. MacMillan**
  - "for the development of asymmetric organocatalysis"

- **2020** - **Emmanuelle Charpentier and Jennifer Doudna**
  - "for the development of a method for genome editing"

- **2019** - **John B. Goodenough, M. Stanley Whittingham and Akira Yoshino**
  - "for the development of lithium ion batteries"

- 2018 - **Frances Arnold**
  - "for the directed evolution of enzymes" and
  - **George Smith and Sir Gregory Winter**
  - "for the phage display of peptides and antibodies"

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The Nobel Assembly, consisting of 50 professors at Karolinska Institutet, awards the Nobel Prize in Physiology or Medicine. Its Nobel Committee evaluates the nominations. Since 1901 the Nobel Prize has been awarded to scientists who have made the most important discoveries for the benefit of humankind.

References

Quantum dots: TV screen crystals win Chemistry Nobel Prize
BBC News

A Nobel prize for quantum dottiness
The Economist, Oct 4th 2023