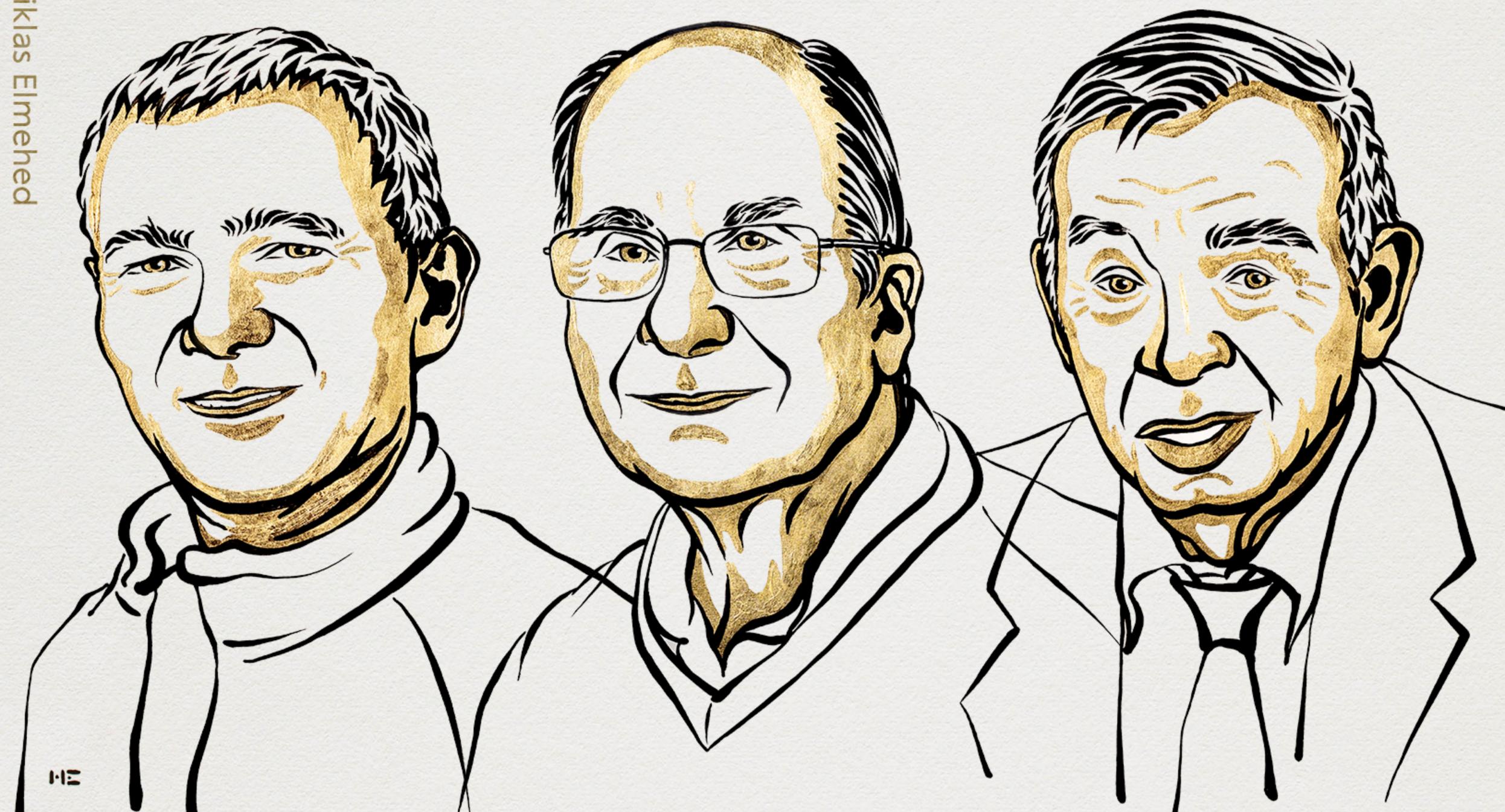


THE NOBEL PRIZE IN CHEMISTRY 2023

Illustrations: Niklas Elmehed



Moungi G.
Bawendi

Louis E.
Brus

Alexei I.
Ekimov

“for the discovery and synthesis of quantum dots”

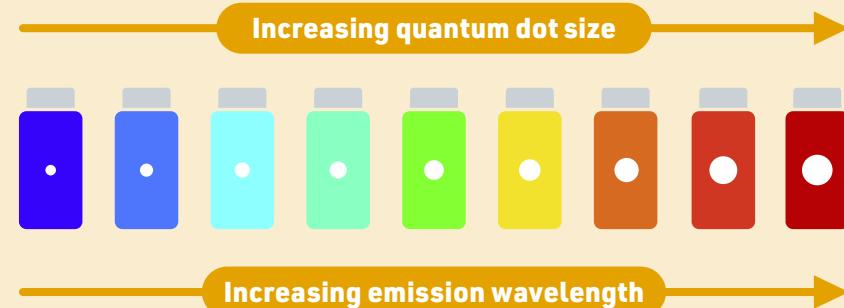
THE ROYAL SWEDISH ACADEMY OF SCIENCES

The 2023 Nobel Prize in Chemistry



The 2023 Nobel Prize in Chemistry was awarded jointly to **Moungi G. Bawendi**, **Louis E. Brus** and **Alexei I. Ekimov** for the discovery and synthesis of quantum dots.

Quantum dots are nanoparticles of semiconducting materials. Their very small size gives them properties that differ from those of larger particles of the same material. For example, their absorption and emission of light varies with size. This is due to quantum effects arising from electrons in the particles being squeezed together.



Smaller particles

Blue



Larger particles

Yellow



Smaller particles

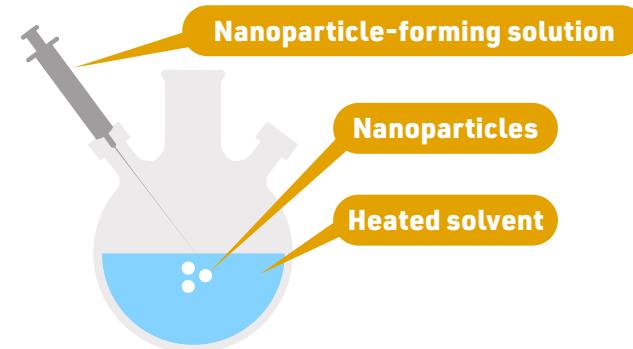
Yellow

CdS



Larger particles

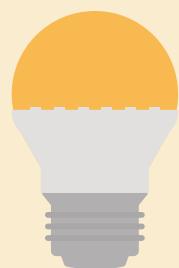
Red



In 1981, **Alexei Ekimov** made glass tinted with copper chloride. He noticed that the size of the copper chloride nanoparticles that formed in the glass affected the glass colour. This was the first time someone deliberately produced quantum dots.

In 1983, **Louis Brus** created solutions of cadmium sulfide nanoparticles, and noticed that the properties of freshly made and older solutions differed. He also discovered that the smaller the nanoparticles, the bluer the light they absorbed and emitted.

In 1993, **Moungi Bawendi** grew nanocrystals of cadmium selenide of a specific size in a solvent which produced smooth and even particles. This effective method for producing quantum dots paved the way for their use in wider applications.



WHY DOES THIS RESEARCH MATTER?

QLED televisions use quantum dots to enhance the colours displayed on screen. They are also used in some LED lamps. Future applications could include flexible electronics, tiny sensors, and thinner solar cells.

Nobel Prize in Chemistry press release: <https://www.nobelprize.org/prizes/chemistry/2023/press-release/>

The Nobel Prize in Chemistry 2023

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry 2023 to

Moungi G. Bawendi

Massachusetts Institute of Technology (MIT),
Cambridge, MA, USA

Louis E. Brus

Columbia University, New York, NY, USA

Aleksey Yekimov

Nanocrystals Technology Inc., New York,
NY, USA

“for the discovery and synthesis of quantum dots”

They planted an important seed for nanotechnology

The Nobel Prize in Chemistry 2023 rewards the discovery and development of *quantum dots*, nanoparticles so tiny that their size determines their properties. These smallest components of nanotechnology now spread their light from televisions and LED lamps, and can also guide surgeons when they remove tumour tissue, among many other things.

Everyone who studies chemistry learns that an element's properties are governed by how many electrons it has. However, when matter shrinks to nano-dimensions quantum phenomena arise; these are governed by the size of the matter. The Nobel Laureates in Chemistry 2023 have succeeded in producing particles so small that their properties are determined by quantum phenomena. The particles, which are called quantum dots, are now of great importance in nanotechnology.

“Quantum dots have many fascinating and unusual properties. Importantly, they have different colours depending on their size,” says Johan Åqvist, Chair of the Nobel Committee for Chemistry.

Physicists had long known that in theory size-dependent quantum effects could arise in nanoparticles, but at that time it was almost impossible to sculpt in nano-dimensions. Therefore, few people believed that this knowledge would be put to practical use.

However, in the early 1980s, **Aleksey Yekimov** succeeded in creating size-dependent quantum effects in coloured glass. The colour came from nanoparticles of copper chloride and Yekimov demonstrated that the particle size affected the colour of the glass via quantum effects.

A few years later, **Louis Brus** was the first scientist in the world to prove size-dependent quantum effects in particles floating freely in a fluid.

In 1993, **Moungi Bawendi** revolutionised the chemical production of quantum dots, resulting in almost perfect particles. This high quality was necessary for them to be utilised in applications.

Quantum dots now illuminate computer monitors and television screens based on QLED technology. They also add nuance to the light of some LED lamps, and biochemists and doctors use them to map biological tissue.

Quantum dots are thus bringing the greatest benefit to humankind. Researchers believe that in the future they could contribute to flexible electronics, tiny sensors, thinner solar cells and encrypted quantum communication – so we have just started exploring the potential of these tiny particles.

Moungi G. Bawendi, born 1961 in Paris, France. PhD 1988 from University of Chicago, IL, USA. Professor at Massachusetts Institute of Technology (MIT), Cambridge, MA, USA.

Louis E. Brus, born 1943 in Cleveland, OH, USA. PhD 1969 from Columbia University, New York, NY, USA. Professor at Columbia University, New York, NY, USA.

Aleksey Yekimov, born 1945 in the former USSR. PhD 1974 from Ioffe Physical-Technical Institute, Saint Petersburg, Russia. Formerly Chief Scientist at Nanocrystals Technology Inc., New York, NY, USA.

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

Further information: www.kva.se and www.nobelprize.org

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The Royal Swedish Academy of Sciences, founded in 1739, is an independent organisation whose overall objective is to promote the sciences and strengthen their influence in society. The Academy takes special responsibility for the natural sciences and mathematics, but endeavours to promote the exchange of ideas between various disciplines.

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