Surface-Passivated Silicon Quantum Dot Phosphors

This technology offers a synthesis of brightly fluorescent colloidal silicon quantum dots that are low cost and produced at a large-scale compared to conventional methods that are high cost and toxic from heavy metal ingredients. The method involves electrochemical etching of 6-inch silicon wafers to produce silicon nanoparticles that are a heavy-metal-free composition, chemical stability and abundant in starting materials.

What is the Problem?

Semiconductor quantum dots (QDs) have shown great potential in solar energy harvesting and the next-generation lighting and display technologies. However, heavy-metal toxicity and costly synthesis are the main barriers that hinder their widespread commercialization. Silicone QDs have been investigated as they are heavy-metal-free. However, most of the synthesis methods require critical conditions, special equipment or complex chemical reactions, all of which make it hard to achieve cost-down and scale-up.

What is the Solution?

SiQDs are heavy-metal-free and have abundant starting materials in nature is a promising substitute for the toxic II-VI QDs. This technology is an experimental method coupled with a novel setup which is capable of synthesizing brightly fluorescent colloidal SiQDs in a low-cost and large-scale manner when compared to existing SiQD synthesis methods. The method begins with electrochemical etching 6-inch silicon wafers to produce silicon nanoparticles, which are then further processed. These SiQDs have many applications, including QD display, LED phosphors, Organic LEDs, bio-imaging, photodetectors and solar cells.

What is the Competitive Advantage?

Current solutions have a high synthesis cost and toxicity from their heavy-metal ingredients, which might shadow their potential for large-scale production and wide-spread commercialization. Other SiQD synthesis methods are high cost and would be difficult to scale up. This invention is a SiQD, which has heavy-metal-free composition, chemical stability and abundant starting materials. The synthesis method is low-cost and could easily translate to high volume manufacturing when compared to the other methods.

Patent Information:

Technology ID

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Category

Materials/Nanomaterials

Selection of Available Technologies

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References

1. Chang-Ching Tu, Ji-Hao Hoo, Karl F Böhringer, Lih Y Lin, Guozhong Cao(41214) , https://pubmed.ncbi.nlm.nih.gov/23164908/, Optics Letters