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PRESS RELEASE

Source: Toyohashi University of Technology, Japan, Committee for Public Relations

Title: Semiconductor nanoparticles show high luminescence in a polymer matrix

Subtitle: Highly luminescent semiconductor nanoparticles immobilized in a polymer matrix using environmentally benign supercritical CO₂

Full text:

Semiconductor nanocrystals known as quantum dots (QDs) are increasingly being used as photoluminescent materials in bio-imaging, photonics, and optoelectronic applications. However, these QDs must have stable photoluminescence properties to be used in these applications. Photoluminescence stability of QDs is achieved by chemically modifying the surface of the QDs.

However, chemical modification of the surface typically requires large amounts of organic solvents that are harmful to the environment. To solve this problem, many researchers have attempted to synthesize polymer-nanoparticle composites by using supercritical fluid (SCF)-based technology. Supercritical CO₂ has emerged as the most extensively studied SCF medium, because it is readily available, inexpensive, nonflammable, and environmentally benign.

Toyohashi Tech researchers in cooperation with researchers at the National Institute of Technology, Kurume College have investigated the formation of nanostructured material using supercritical CO₂. They have demonstrated the formation of composite nanoparticles of luminescent ZnO QDs and polymer by dispersion polymerization in supercritical CO₂. As a result of the supercritical-CO₂-assisted surface modification of QDs, the QDs were well dispersed in the polymer matrix and showed high luminescence.

“Unfortunately, the photoluminescence properties of pristine luminescent QDs were quenched in supercritical CO₂. The surface structure of the QDs was destroyed by supercritical CO₂.”, explains associate professor Kiyoshi Matsuyama at the National Institute of Technology, Kurume College, “We found that the quenching of ZnO QDs could be prevented by coating with silica to obtain PMMA-ZnO composite QDs with high luminescence using a supercritical-CO₂-assisted surface modification with polymer.”

Our research shows that the supercritical-fluid-assisted process provides an environmentally benign route for producing stabilized luminescent materials.



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References:

Kiyoshi Matsuyama, Yu-ki Maeda, Takaaki Matsuda, Tetsuya Okuyama, Hiroyuki Muto (2015)
Formation of poly(methyl methacrylate)-ZnO nanoparticle quantum dot composites by dispersion
polymerization in supercritical CO₂, The Journal of Supercritical Fluids, 103, 83–89.

This article was identified as the “Editor-in-Chief’s Featured Article.”

<http://www.journals.elsevier.com/the-journal-of-supercritical-fluids/featured-articles/latest-editor-in-chiefs-featured-articles/>

Related studies are featured in the September 2015 issue of TUT Research: e-newsletter from
Toyohashi University of Technology

<http://www.tut.ac.jp/english/newsletter/contents/2015/02/features/features.html>

Further information

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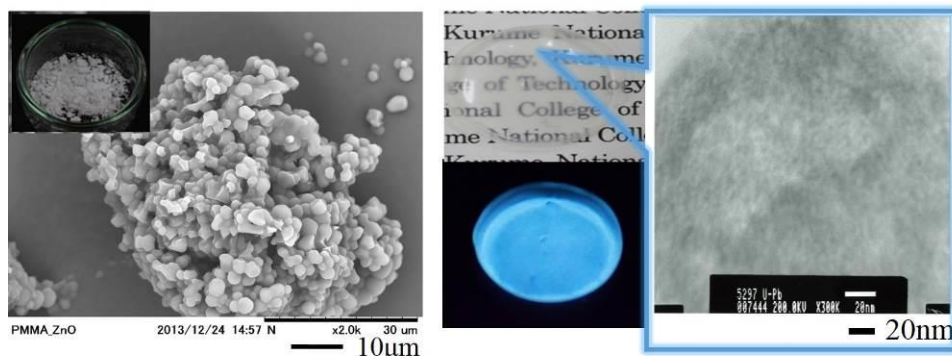


Figure 1:

Configuration of a typical CIGS solar cell

Keywords: CHEMISTRY/PHYSICS/MATERIALS SCIENCES, MATERIALS,
NANOTECHNOLOGY/MICROMACHINES, SUPERCONDUCTORS/SEMICONDUCTORS