Nanocomposites and nanomaterials

Semiconductor light-emitting diode with conversion of wave length

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Semiconductor quantum dots (QDs), as a promising material for absorbing and converting light energy, have attracted intensive scientific and industrial interests. Since the emitting and absorbing characteristics of QDs are dependent on the particles' size, their band structures can be tuned according to the quantum confinement effect by varying the particles' size or compositions. The pure and tunable spectra of QDs make it possible to simultaneously achieve excellent color-rendering properties and high luminous efficiency when combining colloidal QDs with light-emitting diodes (LEDs). Due to the solution-based synthesis route in which QDs was suspended in some organic solvent, QDs are impractical for directly fabrication and integration of light-emitting devices. At least QDs must be incorporated into polymer matrix. Besides, combination of QDs-polymer with LED chip is a key step that converts part of blue or UV light into other wavelengths, so as to generate white light in the end. In addition, to prolong the reliability and lifetime of QD-LEDs, QDs have to be protected from oxygen and moisture penetration.

The operating principle of the experimental LED is based on the re-emission of the active element by a converter material (in this case – nanoheterostructures QDs CdTe / thioglycic acid / copolymer of vinyl acetate acrylate) thus, the short wavelength light of active element leads to the excitation of photoluminescence and the corresponding emission in the long-wavelength region of the spectrum.

In this case, for the production of an effective LED, the main task is the synthesis of qualitative CdTe QD.

QD CdTe synthesized by the method of low-temperature (T = 25° C) colloidal synthesis in a semi-periodic reactor in the presence of a thioglycic acid. Deionized water was densely absorbed into the anisotropic medium. A copolymer of vinyl acetate, acrylate was used as a polymer. Experimental studies have shown that the most optimal is the presence of about 30 monolayers of converter material.

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