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Analysis and Usage of Quantum dot LED

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ABSTRACT
The lookup on the LED base subsequent technology lighting fixtures is actively done in the area of lighting fixtures for the power saving for the world warming prevention. In this study, we made the multifunctional LED light supply as research on the lights equipment that the use of the Quantum Dot. We synthesized the quantum dot having the requisite wavelength and tested the opportunity of attribute comparison end result that it used to be relevant as the result LED fluorescent substance. We make the multi-wavelength LED machine in order to verify the possibility for application for the plant manufacturing unit and evaluated the electrical characteristic of the LED mild source. Also, we evaluated the growth characteristic so that the quantum dot could affirm the possibility for application by means of plant growth light source. Finally we presented the possibility for software of the quantum dot with the multifunction LED light source. The evaluation and utilization of quantum dot LED has been widely discussed in outcomes and discussion.
Index Terms - QD hybrid sol, multifunction LED, Quantum dot, LED, mild source.

1. Introduction

Nano-sized quantum dots with crystal structure was confirmed the characteristic that wavelength was once changed according to dimension of such substances. Adjusting the dimension of quantum dots can be output that converting the wavelength of incident light. The measurement of quantum dots (QDs) is smaller with shorter wavelength light-emitting, and the measurement increases with a longer wavelength of light emitted, and multi-wavelength light-emitting device can be produced is possible by way of mixing the quantum dots of one of a kind sizes.[1–4] For this reason, QDs can be applied to many fields as light-emitting diodes, photovoltaic devices, sensor and bio imaging.[5–8] Application of quantum dots have been studied in a number of fields such as bio-imaging, optical conversion materials, light-emitting materials, photo voltaic mobilephone materials. For examples, one of these applications is the the use of of quantum dots for mild conversion substances that quantum dots used to be utilized for phosphor of light emitting diode (LED), and uses the quantum dots film. LED returned mild unit (BLU) show with top notch of coloration replica is a most traditional utility subject by the usage of vast range of QDs and lookup of utility on the mild supply of synthetic lighting fixtures for high shade rendering light is actively being conducted.[9–11] Artificial mild is used in a variety of field, amongst them, the excessive lighting fixtures efficiency, develop price of plant, disorder prevention are utilized to the facility enlargement and the growth rate is sharply on the rise. High-pressure sodium lamp, metal halide lamp and fluorescent lamp had been used as a mild source for artificial light. To boom of plant using synthetic light, it has a high mild efficiency, however, excessive power, thermal stability, mild excellent and volume of light have been continue to be to

resolve the problem. In order to solve such disadvantages, LED is broadly used as artificial light in the plant factory. Because LED has advantage with energy-saving and reduction of greenhouse gasoline emissions. At present, mild source of LED for the plant growth, the central wavelength of 450nm (blue) or 670nm (red) of LED were used with conjunction together. In this case, It has negative aspects that chip of two must be installed separately. In this study, fabricated LED lamp by way of the usage of QDs as Phosphor, and confirmed the applicability as lights for plant growth used multi-wavelength QDs LED.

2. Experiment

2.1. Preparation of the Quantum Dot/epoxy hybrid sol

In this experiment, used epoxy which is the most extensively used LED encapsulant material (OE-6630, Daw Corning).

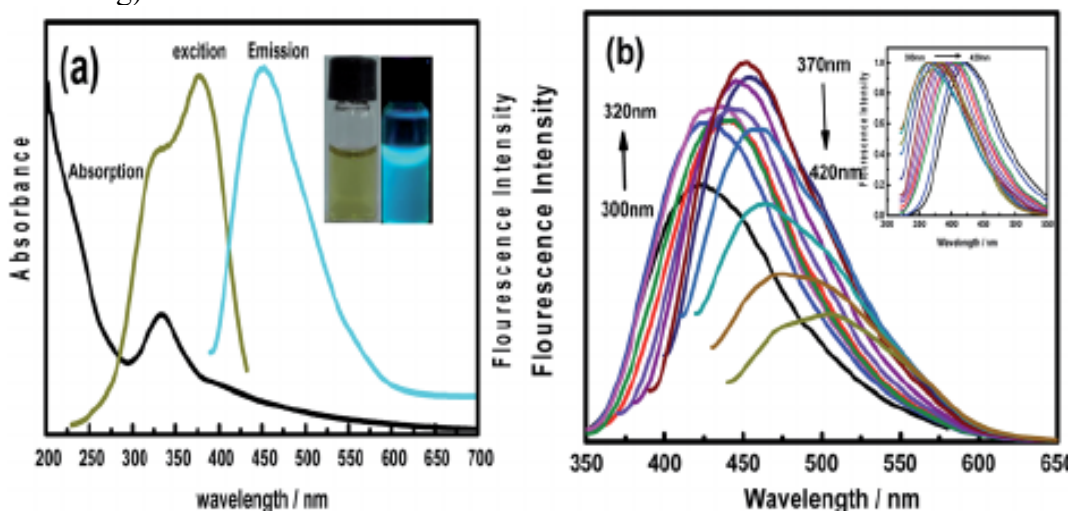

Figure 1. UV-vis optical absorption spectra and corresponding PL emission spectra.

Epoxy has transparency, mild resistance, mechanical energy and handy to forming. Dispersed CdSe/ZnS QD in toluene options (Nanodot HE, QD Solution) had been blended with the epoxy and combination were removed toluene solvent under stirring 500 rpm in vacuum for three hours. Figure 1. UV-vis optical absorption spectra and corresponding PL emission spectra. Figure 2. two (a) TG-DTA of Quantum Dot (b)TG-DTA of QD/epoxy hybrid sol.

2.2. Preparation of QD LED

The Blue InGaN LEDs with the peak emission at 455nm have been used. The combination of QDs and epoxy hybrid sol used to be dispensed on top of the blue LED using dispenser (Ultimus I, EFD) and cured at 100°C for 4h in oven.

2.3. Measurement and Analysis

Optical absorption, PL, and Quantum Yield (QY) of the QD have been measured the usage of a UV–vis spectrophotometer (SD-1000, Scinco), a fluorometer (Fluorolog, Horiba Jobin Yvon), and an absolute QY measurement system (C-9920- 02, Hamamatsu) at room temperature. Thermal balance take a look at of the Quantum Dot/epoxy hybrid sol have been measured using TGA (Q50, TA instruments). For photonic analysis, Color coordinate of QD LED had been measured using the integrating sphere (photonlight series, Majantys) and photosynthetic photon flux density(Skye Instruments) of QD LED measured on 20cm beneath the mild source.

3. Results and Discussion

Dispersed CdSe/ZnS QDs(QY=91%, FWHM=33nm, PL max=632nm) in encapsulant substances and characterization of QDs. As a end result the encapsulated materials (0.03wt% QD disperse in OE-6630) has a desirable property.(Quantum yield=86%, FWHM=32nm, PLmax=635nm) Even although the quantum effectivity of about 6.5% decrease, spectroscopic houses have been stored consistent (Figure 1). The quantum dot and encapsulant substances is raised to 200 °C for 1 hour TG-DTA used to be measured for confirm to thermal stability. The quantum dot solution whilst heating until 200 °C had no trade in weight, QD / epoxy hybrid sol is steady used to be found to be well maintained.(Figure 2). As a result, The thermal balance of QDs and encapsulant substances is secure below 200°C which is under LED`s operation temperature. 510nm, 610nm wavelength in the seen area mild affected shield of plant disease, and wavelength of 660nm of the light to maximize the motion of chlorophyll in the plants, is recognized to influence germination. Based on this, select the foremost scale at 510nm, 610nm, 660nm of quantum dots the use of the fluorescence spectrophotometer, and each of the quantum dots were mixed. LED package was once manufactured for using that quantum dots was once mixed in encapsulant substances (Figure 3). As a end result of measuring common light beam affectivity of LED bar used to be one hundred fifteen lm/w, and photosynthetic quantum flux was measured 190μmol m−2• s−1 and most 203μmol m−2• s−1. So we validated that it used to be suitable mild supply for plant growth.

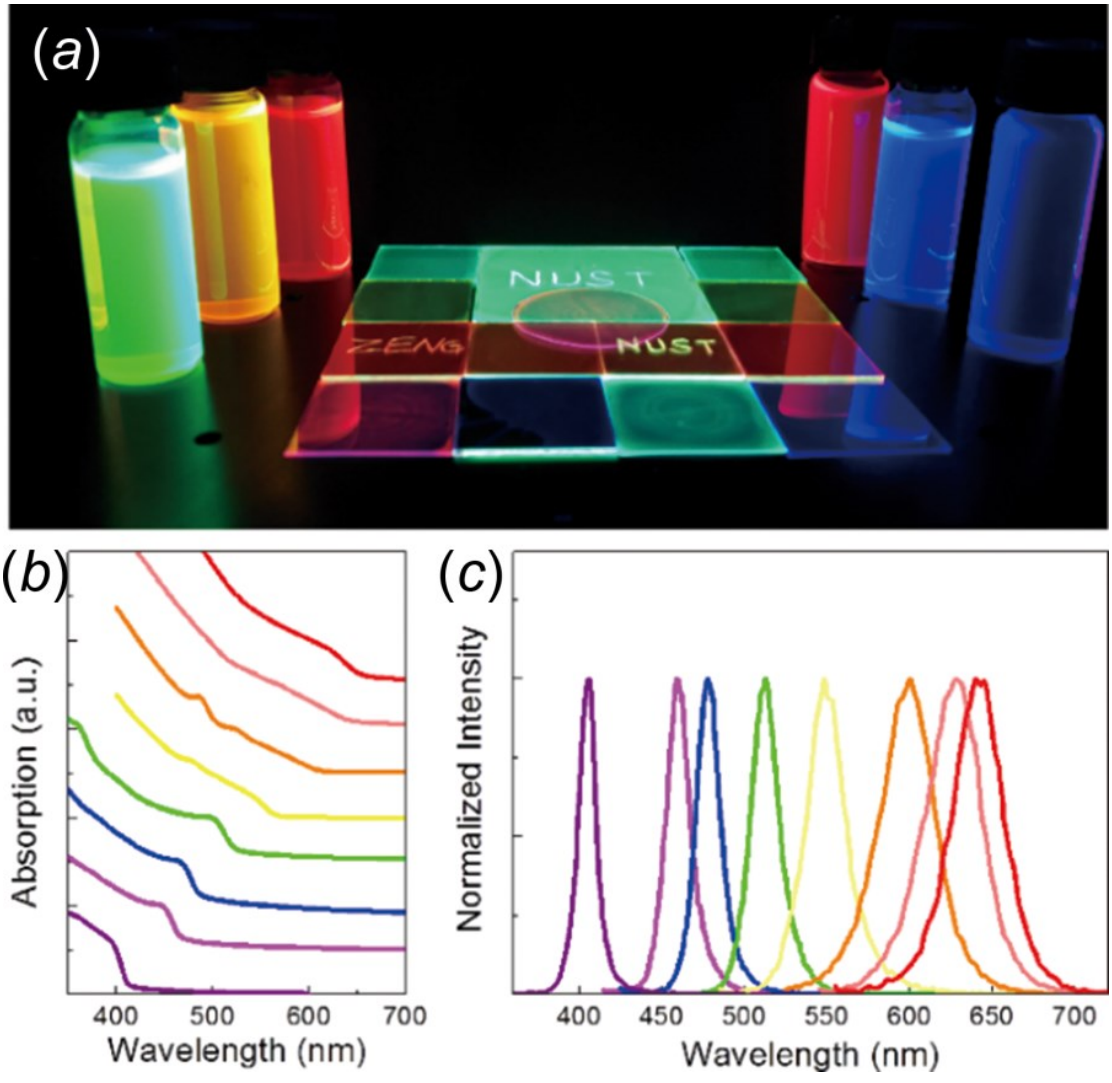

Figure 3. (a) Quantum Dot LED (B & C) wavelength of Quantum Dot LED.

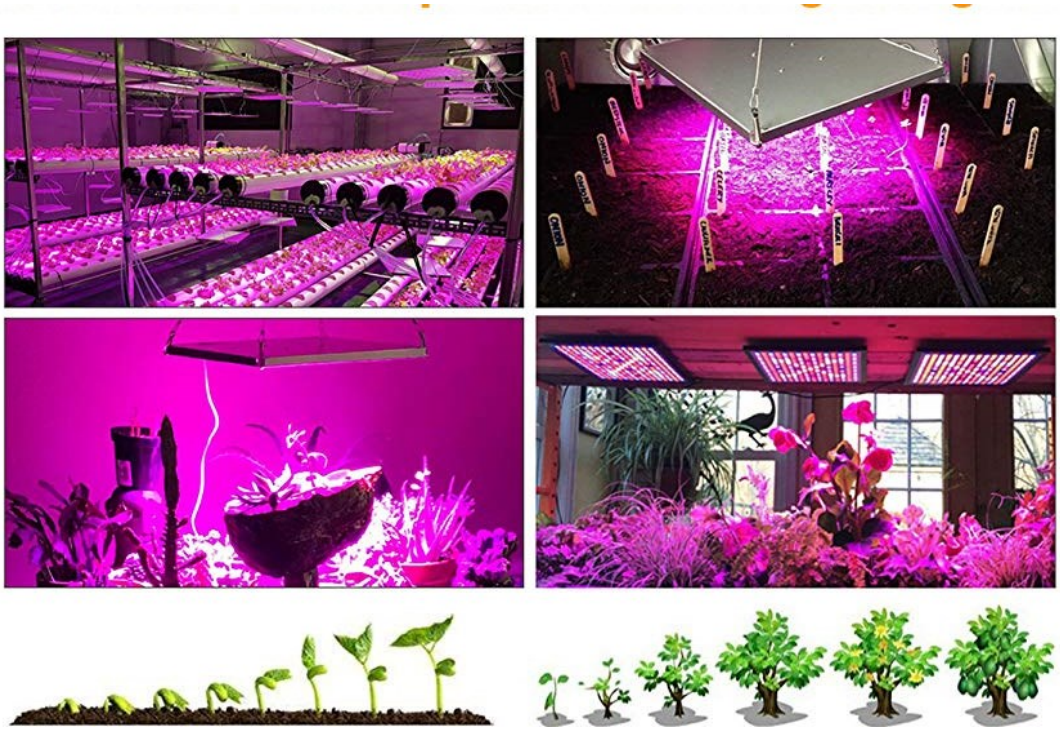

Fig. 4. (a) Plant growth instruments (after 30 days).

Have carried out plant boom experiments the use of the fabricated LED for verify applicability of light source for plant growth. After making ready the experimental team (QDs LED) and the manipulate group (white LED) to 50X30 cm cultivation phase, have conducted plant boom experiments to plant red lettuce(14 heads per cultivation phase). Each test group has three LED bar(used 33ea LED) and LED mild source used 12V and 60mA(average of potsoynthetic phtoon flux density per 1ea LED 19.7 lm, common of luminous efficiency one hundred fifteen lm/W) The take a look at surroundings used to be Ph 6.7~6.9(nutrient answer concentration), 0.8~1.2(concentration of EC), 22~26°C(temperature). Fig. 4 Results of experiments performed by way of 30 days, growth common of control crew referred to as White LED used to be 18cm, increase average of experimental group(QDs LED) was 25cm. In these experiments, has confirmed that the experimental group was once higher than the manipulate group. As a result, validated relevant opportunity as lights for plant boom used multi-wavelength QDs LED.

4. Conclusion

In this paper, fabricated LED with the aid of the use of QDs as Phosphor, and tested applicable opportunity as lights for plant increase used multi-wavelength QDs LED. As a result, proven appropriate software of LED as used QDs because quantum dot has viable to multi-wavelength, dispersed in LED encapsulant materials and terrific in thermal stability. Existing LED can be utilized as a quantum dot, and confirmed applicable possibility as quantum dot at a nano-materials of new high-performance.

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