International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-1, November 2019

The Effect of Silicon-Organic Modifier of CdZnS/ZnS (GT) Quantum Dot with Wavelength 390 nm on cathodoluminescent mode

Majmaa Huda Khalid Hameed, Sheshin E.P.

Abstract: Surface modification of quantum Dots is very demanding to improve the optical properties of quantum Dots and it is generally carried out by depositing an organic or an inorganic layer on the quantum Dots. In this study the behavior of CdZnS/ZnS and CdZnS/ZnS (GT), both emitting at 390 nm, differ by silicon-organic additives studying in a vacuum chamber to find out their feature and to identify the luminescent of quantum Dots, under the action of electron bombardment to assess the capability of quantum Dots as phosphors for further use in vacuum electronics

Keywords: quantum dots, core/shell quantum dots, light sources, cathodoluminescence, passivation, CdZnS/ZnS, CdZnS/ZnS (GT)

I. INTRODUCTION

Progress in wet chemistry has created a powerful path to synthesis of highly luminous semiconductor nanocrystals of sizes from 1.5 to 8 nanometers. By wisely controlling the conditions of growth, size, and even the shape of II-VI, nanocrystals can be accurately designed. The ability to control these standards has a deep effect on materials science and can be used to manufacture engineering assemblies for nanometer units with new properties [1]. At this stage, a distinguished focus was the optical properties of these semiconductor nanocrystals They are ruled by the effects of strong quantum confinement and therefore depend on size. Absorption start and fluorescence emission transfer to greater energy with decreasing size. Moreover, the absorption spectrum is a continuum from the bandgap to the UV, The emission pattern is narrow and symmetrical and does not rely on the excitation frequency. Thus, many different sizes of nanocrystals can be excited simultaneously with a single excitation source, resulting in well-determined emission colors. Additional passivation of the nanocrystalline surface by a thin shell of a higher bandgap material does not significantly alter the absorption and emission characteristics, but increases the yield of the amount of nanoparticles up to 50-70%.

Revised Manuscript Received on November 30, 2019.
***** Correspondence Author
Majmaa Huda Khalid Hameed*, Moscow Institute of Physics and Technology 9 Institutsky per., Dolgoprudny, Moscow Region, 141701,Russian Federation
Sheshin E.P., Moscow Institute of Physics and Technology 9 Institutsky per., Dolgoprudny, Moscow Region, 141701, Russian Federation

The passivation shell also realizes effective photochemical stability, so that photobleaching is reduced, and the number of photons that a single nanocrystal can emit dramatically increases [2].

II. QUANTUM DOTS BASIC INFORMATION

Quantum dots (QDs): are isolated nano-objects whose properties differ significantly from the properties of a bulk material of the same composition. It should be noted right away that quantum dots are more of a mathematical model than real objects. And this is due to the impossibility of forming completely separate structures.

First of all, quantum dots are of practical interest as luminescent materials. Basic requirements presented in semiconductor materials, on the basis of which quantum dots are synthesized, are the direct-band nature of the bandgap. It provides effective luminescence.

Enhanced the manifestation of the confined effect in a fairly wide range of sizes (of course, by the standards of nanocrystals). Also, the following classes of semiconductor materials can be distinguished. Wide-gap semiconductors (ZnO, TiO2 oxides) - ultraviolet range. Mid-season semiconductors (e.g. cadmium chalcogenides) - visible range.

In addition to the composition and size of a serious impact on the properties of quantum dots will have their shape [2,3].

- *Spherical* - most of the quantum dots. At the moment, have the greatest practical application. The most simple to manufacture.
- *Ellipsoidal* - nanocrystals elongated along one direction.
- *Complex geometry nanocrystals*. It is possible to synthesize crystals having rather diverse, complex geometry variants: cuboids, asteroids, branched fractal structures and so on

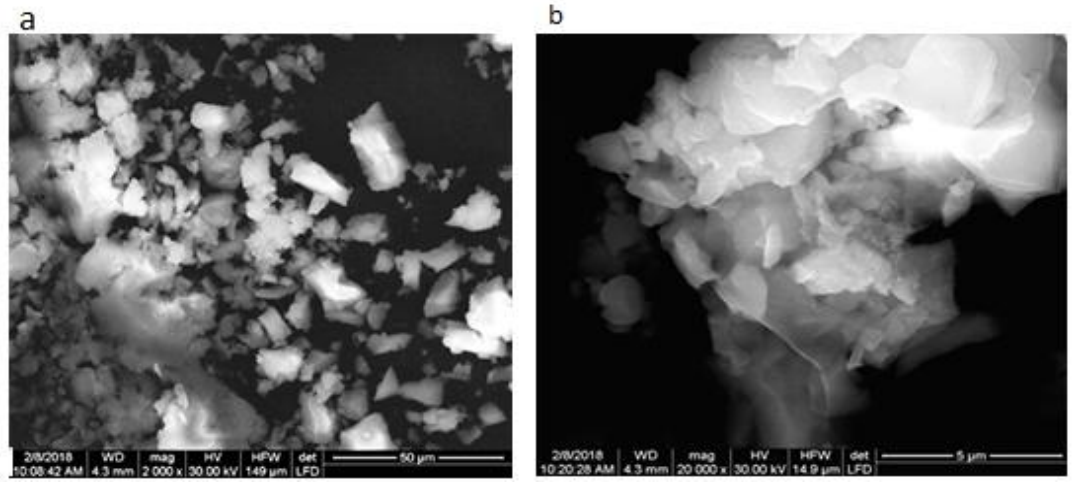
The methods of colloid chemistry make it possible to synthesize multicomponent quantum dots from semiconductors with different characteristics, primarily with different widths of the forbidden band.

Based on the information previously mentioned, this research is devoted to the study of CdZnS / ZnS, CdZnS / ZnS (GT), and their properties depending on their composition, as well as to study the luminescent of QDs in a vacuum chamber. To assess the possibility of using these quantum dots as phosphorus for further use in vacuum electronics. Also, we will focus on the effect of silica shell on the optical properties of nanocrystals [4].

III. EXPERIMENTAL WORK

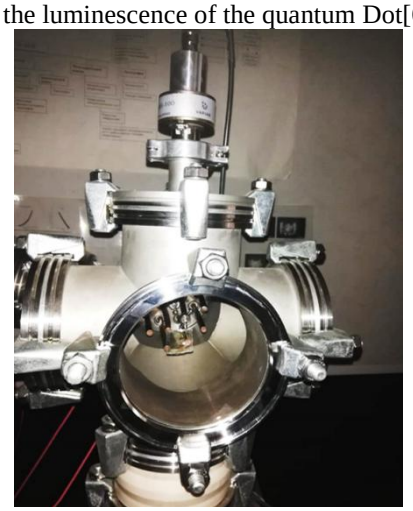
The experimental part consists of studying the behavior of quantum dots in the vacuum setup and assessing the possibility of using the latter as phosphorus.

We have two samples of CdZnS/ZnS and CdZnS/ZnS (GT) quantum dots of the form of toluene colloid solution were purchased and applied to an ITO conducting glass substrate via the deposition method. The samples were then dried at 80°C for 4 hours. Initially, the samples were examined separately in scanning electron microscopy (SEM). To obtain images of the surface of quantum dots at different resolutions. (Figures .1) So as to control application uniformity [5,6].



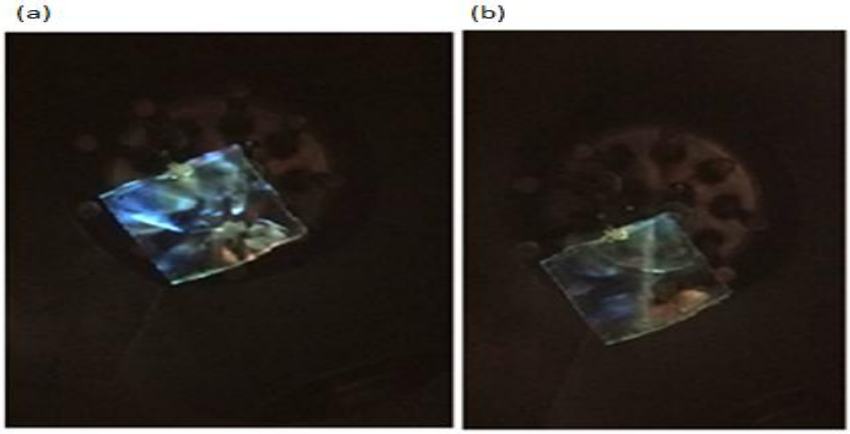
(Fig. 1) Shows the SEM imaging, (a) CdZnS/ZnS (b) CdZnS/ZnS (GT) Quantum Dots

Then we placed the sample in a vacuum chamber (Fig. 2), fixed the flange, put it on the pump to the pressure we needed (10^{-6} mm Hg). After 3-4 hours, the spectrometer was connected and a voltage was applied (from 3.75 kv-9 kv) to achieve the luminescence of the quantum Dot[6].



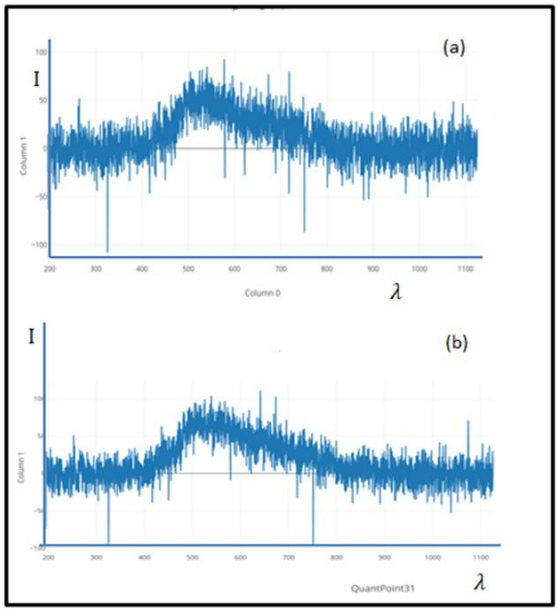
(Fig. 2) The specimens in a vacuum chamber

A difference in the intensity of the glow was observed in the studied samples of quantum dots. CdZnS / ZnS had a strong glow for a short period when activated at 6.7 kV, 300 μA. While CdZnS / ZnS (GT) glowed very weak for a very short period at activation 5 kV, 300 μA. The reduction in radiation intensity occurred in less than a minute and no subsequent attempt to reactivate was successful [6]. Theoretically, this situation can be explained by the fact that the degradation of quantum dots under the electron current and the concentration of quantum dots in the studied samples are insufficient Shown in (Fig.3).



(Fig.3) Shows the Glow of (a) CdZnS/ZnS (b) CdZnS/ZnS (GT) quantum Dots

We obtained emission spectra QDs in a vacuum setup under the effect of electronic bombardment (Figures 4.). There is a large amount of noise in the spectra, due to the short lifetime of the quantum dot.



(Fig.4) Shows the cathodoluminescent spectrum of the samples

According to the experimental results obtained, further research may be impractical for these samples and that additions to silicon-organic modifiers did not contribute to the improvement of the quantum Dots specification studied since the thickness of the coating has profound effects on the luminescence properties of Qdots. Thick coat layers may lead to inappropriate imbalances which are also non-radioactive recombination sites that reduce PL-QY.

IV. CONCLUSION

From previous experiments, it is possible to conclude that the duration of operation of quantum dots may still be insufficient to make them a kind of phosphor anode. Also, the silicon-organic modifier added to the quantum dots studied did not contribute to improved specimens' lifetime, which requires the opposite. I think that quantum dot sample preparation was not at the required level. Furthermore the characterization techniques available are unable to provide information about the interface bonding of core and shell, this calls for new characterization techniques that can provide more advanced information on the shell structure in the core/shell quantum dots

REFERENCES

1. Bondarenko B.V., Rybakov Yu.L., Shakhovskoi A.G., Sheshin E.P., //Some features of the process of stabilization of field emission characteristics of carbon fibers. //Theses of the reports of the XIX All Union Conference on Emission Electronics. Tashkent. 1984. P. 31. (Russian).
2. Levshin V.L. *et al*. Researching cathodoluminescence of ZnS and some other phosphors // Works of P.N. Lebedev's Institute of Physics. 1963. pp. 64–135.
3. Klimov V.I., Ed. Nanocrystal Quantum Dots (2nd Ed.). // CRC Press, 2010.
4. Ozol D.I. Preliminary study of cathode ray tube phosphors on the basis of nanocrystal quantum dots // 29th International Vacuum Nanoelectronics Conference (IVNC), 2016, Vancouver, BC, 2016, pp. 1-2.
5. Dezhurov S.V. *et al*. Synthesizing highly stable colloid quantum dots CDTESE/CDS/CDANS/ZNS, exhibiting fluorescence in 650-750 nm range // Russian nanotechnology, 2016, #5-6 pp. 69-74.
6. Majmaa Huda k.,Sheshin E.P.// Researching CdZnS/ZnS (GT) Quantum Dots in Cathodoluminescent Mode// International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8, Issue- 9S2, July 2019