Tuned Reactivity Effects on the Structural and Optical Properties of Chemical Composition Gradient Quantum Dots

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Industries bring the technology to home through the immense effort of solving technical problem but cost of developing green, cheap, reproducible materials would be remain challenges. Bottom-up nanomaterial fabrication would be cheaper than top-down approach but the lack of reproducibility and controllability fails to face the material quality test, which is crucial for mass production. Bottom-up approach involves the nanoparticle formation from the clusters of few 100~1000 atoms, which is sensitive for chemical and physical process that takes place in the synthesis phase. Detailed inferring and mechanism of controllability and reproducibility of material at cluster to nanoparticle formation could be well understood by the fate of chemical and physical process that extending in the synthesis phase which directly reveal the size, shape and bandgap formation. Here we investigated the nanoparticle formation in the single pot synthesis scheme by hot solution injection method, in particular, the chemical composition gradient CdSe/ZnSe/ZnS Quantum Dot nanoparticles formation. The chemical reactivity would affected by molar ratio of initial materials, concentration of charged species, reducing agents, non-coordination solvents, pH solution phase, monomer concentration, bond formation also the physical factors of temperature induced activation energy, charges, cluster formation, saturation, initial nucleation, energy state formation. In the experimental section initial source materials of Cadmium oxide (CdO, 99.99%), zinc acetate (99.9%), selenium stock solution dissolved in trioctylphosphine (TOP, 90%), oleic acid (OA, 90%) as reducing agent, 1-octadecene (ODE, 90%) as non-coordination solvents of synthesis, and 1-Dodecanethiol (>98%) were used in the synthesis. The reactivity was started tuning from the ratio of OA and ODE, 1:1, 3:7, 7:3. The phase separated and diluted state of solvents was used with other factors constants. The reactivity and pH changes, cluster growth kinetics were monitored throughout the reaction which yields the change in the redshift in the absorption peak, cluster growth and photoluminescence variation

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Fig. 1. HRTEM Image of QDs (a), SEM Image of Alumina (b) **Fig. 2. Lambertion Patterns of QDs film**

The efficient down conversion of blue Photon to Red were realized by Konica Minolta Spectroradiometer and the achieved enhancement were 115% (1.15 times), it was further enhanced to 140% (1.4 times) through outcoupling process by attaching Alumina (Al_2O_3) micro particle on QDs film. The Lambertion emission pattern shown in Figure 2, which is efficient and superior than the typical results of Polymer matrix QDs film.

The QDs and QDs films were critically investigated further such as the internal and external morphologies as shown in Figure 1, by HRTEM, HRXRD, SEM as well as optical properties by UV-visible Absorption spectrum, PL fluorescence mode and Quantum Yield. There were ongoing investigations of material process, technical optimization and hybrid film of optically sensitive for the best attainment of Photon down conversion.

Acknowledgment

The authors thank Professors Jeong Ho Cho for the Laboratory provisions, Heeyeop Chae and Dae Ho Yoon for technical discussions.

This research was supported by the MSIP (Ministry of Science, ICT & Future Planning), Korea, under the ITRC (Information Technology Research Center)) support program NIPA-2015-(H0301-14-1009) supervised by the NIPA (National IT Industry Promotion Agency).

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