EFFECT OF POTASSIUM CHLORIDE ON OPTICAL PROPERTIES OF NICKEL COMPOUND QUANTUM DOTS PREPARED VIA ELECTROCHEMICAL PROCESS

Pornarpa Nantachai, Siripatsorn Thanasanvornakun,
Surachet Phadungdhitidhada, Sukrit Sucharitakul, and Supab Choopun

Department of Physics and Materials Science, Facility of Science, Chiang Mai University, Chiang Mai 50200, Thailand

Abstract

Nickel compound quantum dots (Ni compound QDs) are widely applied in many applications and can be used as a precursor for nickel oxide preparation. In this work, the effect of potassium chloride concentrations is investigated for nickel compounds quantum dots preparation by using an electrochemical process. For the synthesis procedure, electrolytes are prepared by KCl concentrations at 0.1 M, 0.2 M, 0.3 M and 0.4 M which are control variables mixed with a fixed citric acid ($C_6H_8O_7$) concentration at 0.1 M. Then, an electric potential of 3 volts is applied for 40 minutes. The optical properties of Ni compound QDs are characterized by using ultraviolet visible spectroscopy (UV-vis), Photoluminescent spectroscopy (PL) and Dynamic light scattering (DLS). As the results, the as-synthesized Ni compound QDs solution clearly exhibits two layers of NiOOH (top layer) and $NiCl_2$ (bottom layer) which are confirmed by UV-Vis results. For bandgap of Ni compound QDs, the condition of KCl 0.1 M reveals the highest bandgap value for both the top and bottom Ni compound QDs. For PL results, the light emission in top layer shows the highest peak at KCl 0.2 M corresponding to that of NiOOH. Meanwhile, the lower layer shows the highest peak at KCl 0.4 M corresponding to that of $NiCl_2$. Besides, the hydrodynamic size of Ni compound QDs is in the order of hundreds of nanometers as confirmed by DLS results. Therefore, it can be concluded that the optical properties of Ni compound QDs are affected by KCl concentration, indicating their potential of Ni compound QDs for tunable optical properties which are useful for optoelectronic and perovskite solar cell applications.

Objective

- To study effect of Potassium Chloride on Optical Properties of Nickel Compound Quantum Dots Prepared via Electrochemical Process

Synthesis Nickel Compound QDs

- Using nickel-metal rods (99.8%) 2mm in dimension and 5 cm in length
- Electrolyte solution: KCL 0.1 - 0.4 M and citric acid (0.1 M)
- Appiled voltages at 3 V for 40 minutes

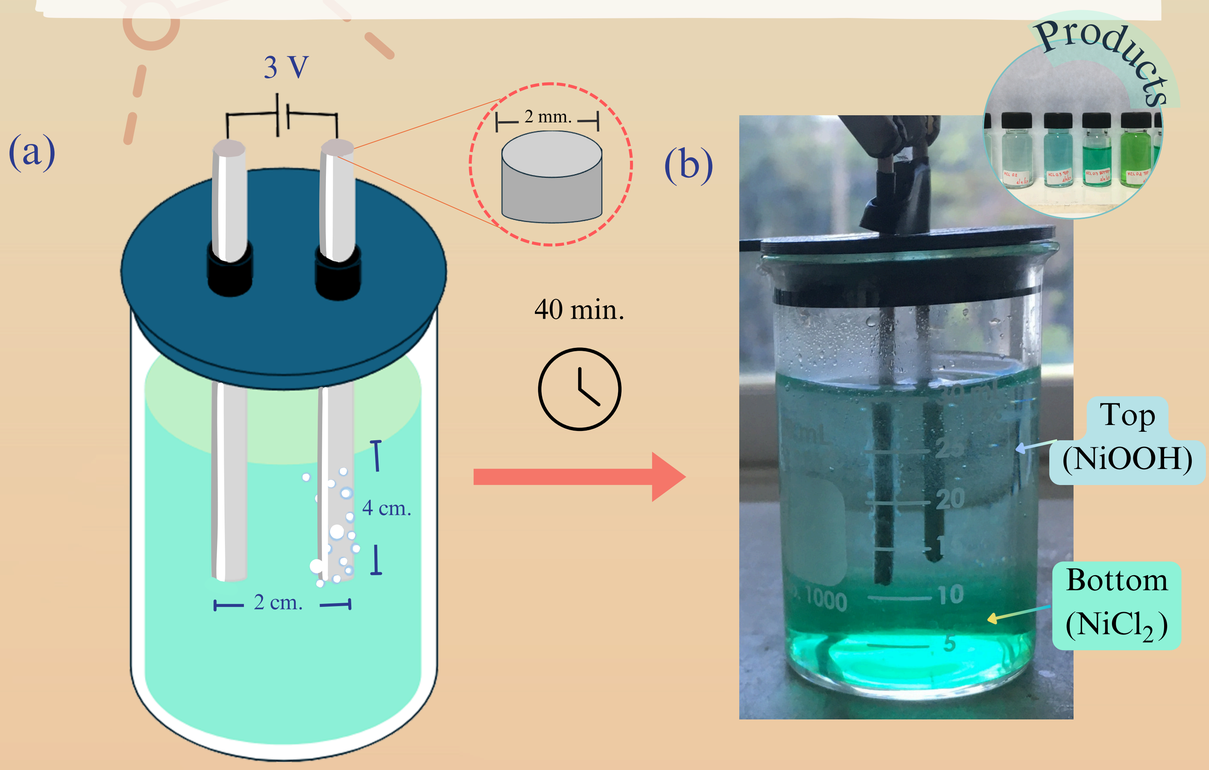

Figure 1 (a) schematic of electrochemical process for Nickel compound Quantum dots synthesis and (b) optical image of Nickel compound Quantum dots product with seperated green layers solution

Characterization of Nickel Compound QDs

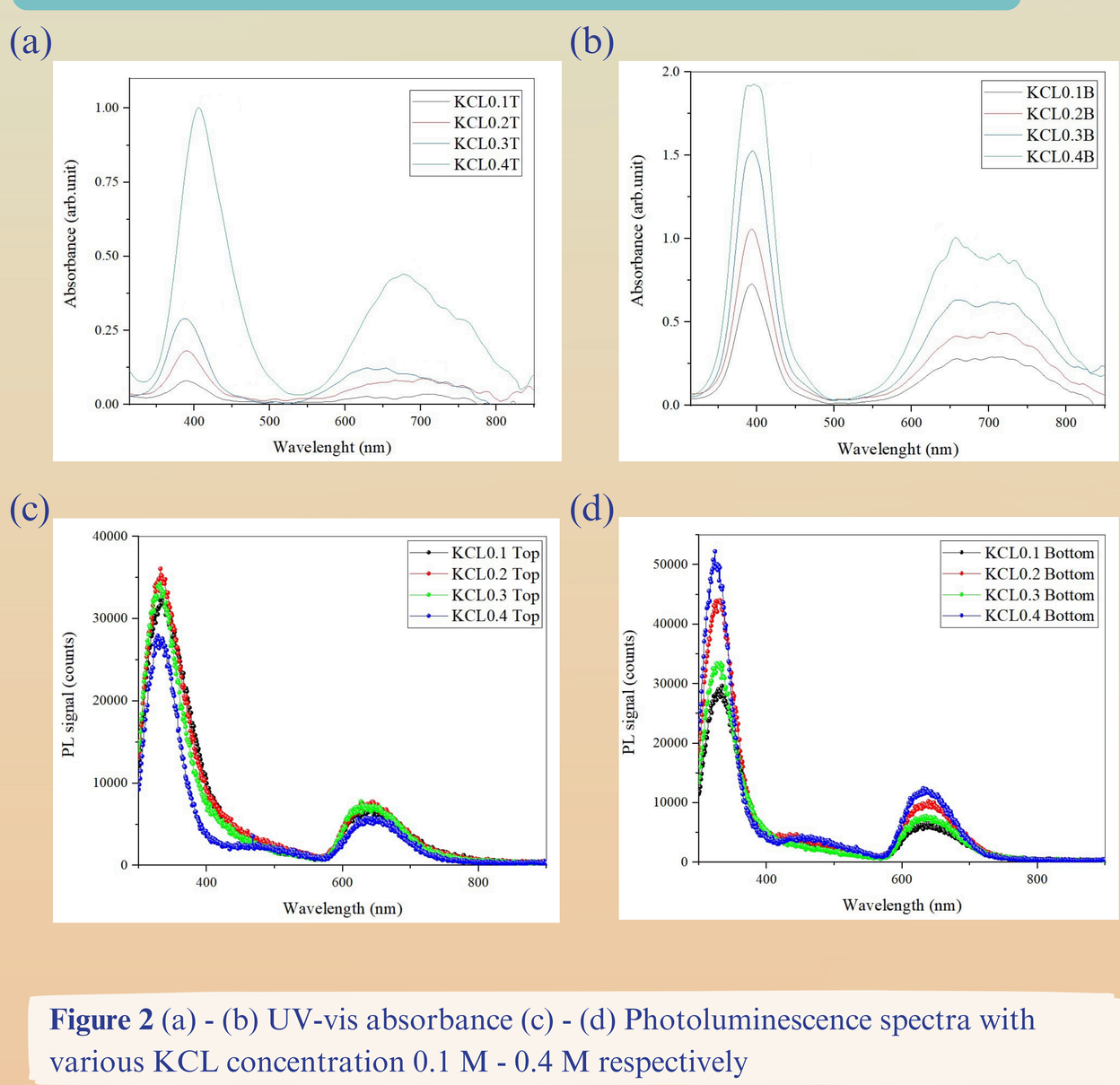

Figure 2 (a) - (b) UV-vis absorbance (c) - (d) Photoluminescence spectra with various KCL concentration 0.1 M - 0.4 M respectively

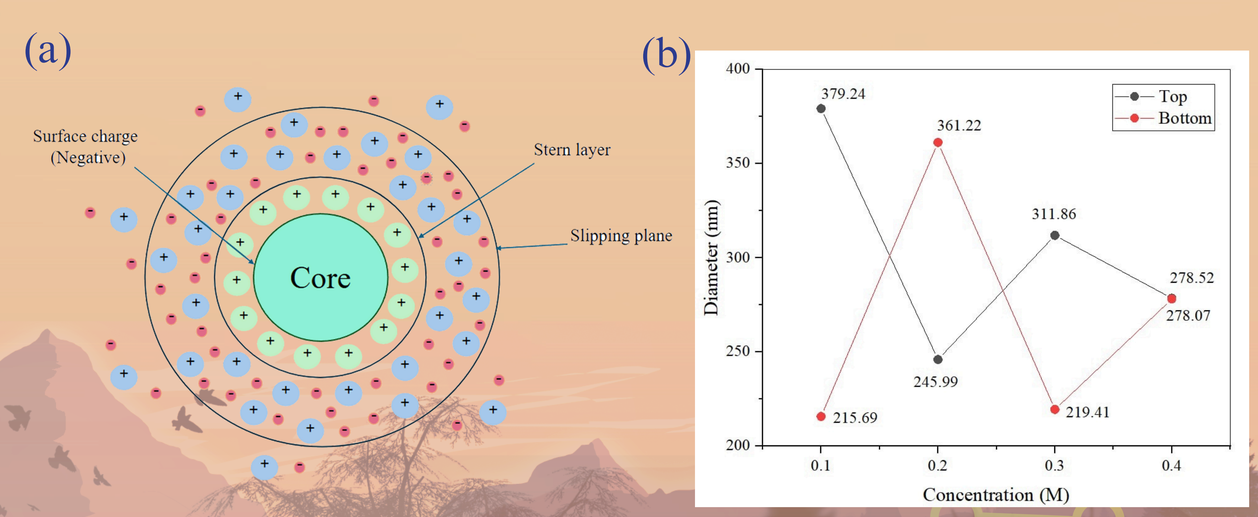

Figure 3 (a) Hydrodynamic size in Nickel compound Quantum dots solution and (b) the increased of hydrodynamic sizes of Nickel compound Quantum dots with various KCL concentration 0.1 M - 0.4 M.

Conclusions

The change in potassium concentration affects the nickel quantum dot compounds. The absorption value is large at 0.4 because of the highest concentration, while the top layer photoluminescence intensity value is large at 0.2 and the bottom layer value is large at 0.4 because they are different nickel quantum dot compounds. As a result, the hydrodynamic particle size is dependent on the agglomeration characteristics of OH according to the type of nickel quantum dot compounds.

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