Supporting Information: Highly Efficient Cd-free Alloyed 
Core/Shell Quantum Dots with Optimized Precursor 
Concentrations

Yemliha Altintas a,#, Mohammad Younis Talpur b,#, Miray Ünlü a, Evren Mutlugün b*

aDepartment of Materials Science and Nanotechnology, Abdullah Gül University, Kayseri, Turkey TR-38039.
bDepartment of Electrical-Electronics Engineering, Abdullah Gül University, Kayseri, Turkey TR-38039.
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The authors contributed equally to this work
Phone no: +90-352-2248800
Corresponding author: *evren.mutlugun@agu.edu.tr

Instruments for characterization. The synthesized InPZnS alloy/ZnS shell QDs have been characterized using Ultraviolet-visible (UV-vis) spectrophotometer, photoluminescence (PL) spectroscopy, time resolved PL, Fourier transform infrared (FTIR) spectroscopy, X-ray Diffraction (XRD) and Transmission Electron Microscopy (TEM), respectively.

Dilute samples of QDs (In hexane) were characterized by UV-visible spectrophotometer (Shimadzu UV-1800). Absorbance spectrum was measured in the range of 300 to 700 nm with a 1cm width quartz cell. Infrared spectra were recorded on a FTIR spectrometer (Thermo Scientific Nicolet-6700) fitted equipped with deuterated triglycine sulfate (DTGS) detector. IR spectra of QDs were collected in the mid IR region at 4000-650 cm\(^{-1}\) with 32 scans and 4 cm\(^{-1}\) resolution, respectively. The PL spectra were obtained by using fluorescence Spectrophotometer (Agilent, Cary Eclipse) and recorded in visible spectrum at room
temperature. Time resolved PL measurements have been carried out using Pico Quant FluoTime 200. XRD images of QDs were taken by Panalytical X'pert Pro MPD. TEM samples were prepared by drying a drop of synthesized QDs on amorphous carbon-coated copper grids, and transmission electron microscopy images were taken by using (FEI, Tecnai G2 F30) instrument.

**Experimental Section:** Synthesis of InPZnS/ZnS quantum dots from blue to red peak emission.

**484 nm emitting QDs:**

Indium acetate (0.1 mmol), myristic acid (0.3 mmol) and 6 ml of octadecene were added in the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc stearate (0.2 mmol) and 1-dodecanethiol (0.2 mmol) were added and heated to 220°C (under inert Ar atmosphere). Following, tris(trimethylsilyl)phosphine (0.1 mmol in 1 mL octadecene) was injected into the hot solution at 220°C. The solution was kept at 285°C for 10 min and then was cooled to room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C. After 3 hours, 1-dodecanethiol (0.4 mmol in 1 mL octadecene) was injected by syringe pump (4 mL/hour) into the flask and kept at that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including unreacted species of ligands and other precursors were removed by 5 ml hexane, centrifuging at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20 ml of acetone and 3 ml methanol at 5000 rpm for 10 min, repeatedly. The final product was re-dissolved in hexane.
**499 nm emitting QDs**

Indium acetate (0.1 mmol), myristic acid (0.3 mmol) and 8 ml of octadecene were added in the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc stearate (0.2 mmol) was added and flask was heated to 220°C (under inert Ar atmosphere). After that, 1-dodecanethiol (0.1 mmol) was added into the solution at 260°C and kept for 10 min. Next, tris(trimethylsilyl)phosphine (0.1 mmol in 1 mL octadecene) was injected into the hot solution at 260°C. The solution was kept at 260°C for 15 min and then was cooled to room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C under Ar flow. After 3 hours, 1-dodecanethiol (0.4 mmol in 1 ml octadecene) was injected by syringe pump (4ml/hour) into the flask and kept at that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including unreacted species of ligands and other precursors were removed by 5 ml hexane, centrifuging at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20ml of acetone and 3ml methanol, then, centrifuged at 5000 rpm for 10 min, repeatedly. The final product was re-dissolved in hexane.

**514 nm emitting QDs**

Indium acetate (0.1 mmol), myristic acid (0.3 mmol) and 8 ml of octadecene were added in the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc stearate (0.1 mmol) and 1-dodecanethiol (0.1 mmol) were added and heated to 220°C (under inert Ar atmosphere). Following, tris(trimethylsilyl)phosphine (0.1 mmol in 1 mL octadecene) was injected into the hot solution at 220°C. The temperature of the solution was increased to 285°C and kept at that temperature for 10 min and then was cooled to room temperature.
For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C under Ar flow. After 3 hours, 1-dodecanethiol (0.4 mmol in 1ml octadecene) was injected by syringe pump (4ml/hour) into the flask and kept at that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including unreacted species of ligands and other precursors were removed by 5 ml hexane, centrifuging at 5000 rpm for 10min. In the next step, the supernatant solution was precipitated with 20ml of acetone and 3 ml methanol, then, centrifuged at 5000 rpm for 10 min, repeatedly. The final product was re-dissolved in hexane.

545 nm emitting QDs

Indium acetate (0.1 mmol), myristic acid (0.43 mmol) and 8 ml of octadecene were added in the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc stearate (0.1 mmol) and 1-dodecanethiol (0.025 mmol) were added and heated to 220°C (under inert Ar atmosphere). Following, tris(trimethylsilyl)phosphine (0.1 mmol in 1 ml octadecene) was injected into the hot solution at 220°C. The solution was kept at 285°C for 10 min and then was cooled to room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C under Ar flow. After 3 hours, 1-dodecanethiol (0.4 mmol in 1ml octadecene) was injected by syringe pump (4ml/hour) into the flask and kept at that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including unreacted species of ligands and other precursors were removed by 5ml hexane, centrifuging at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20 ml of acetone and 3ml methanol, then, centrifuged at 5000 rpm for 10 min repeatedly. The final product was re-dissolved in hexane.
574 nm emitting QDs

Indium acetate (0.1 mmol), myristic acid (0.43 mmol) and 8 ml of octadecene were added in the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc stearate (0.1 mmol) and 1-dodecanethiol (0.01 mmol) were added and heated to 220°C (under inert Ar atmosphere). Following, tris(trimethylsilyl)phosphine (0.1 mmol in 1 ml octadecene) was injected into the hot solution at 220°C. The solution was kept at 285°C for 10 min and then was cooled to room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C under Ar flow. After 3 hours, 1-dodecanethiol (0.4 mmol in 1 ml octadecene) was injected by syringe pump (4 ml/hour) into the flask and kept at that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including unreacted species of ligands and other precursors were removed by 5 ml hexane, centrifuging at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20 ml of acetone and 3 ml methanol, then, centrifuged at 5000 rpm for 10 min, repeatedly. The final product was re-dissolved in hexane.

586 nm emitting QDs

Indium acetate (0.1 mmol), myristic acid (0.43 mmol) and 8 ml of octadecene were added in the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc stearate (0.1 mmol) and 1-dodecanethiol (0.005 mmol) were added and heated to 220°C (under inert Ar atmosphere). Following, tris(trimethylsilyl)phosphine (0.1 mmol in 1 ml octadecene) was injected into the hot solution at 220°C and kept 5 min at this temperature. The solution was heated to 285°C for 10 min and then was cooled at room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C under Ar flow. After 3 hours, 1-dodecanethiol (0.4 mmol in
1ml octadecene) was injected by syringe pump (4 ml/hour) into the flask and kept at that
temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including
unreacted species of ligands and other precursors were removed by 5ml hexane, centrifuging
at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20 ml
of acetone and 3ml methanol, then, centrifuged at 5000rpm for 10 min, repeatedly. The final
product was re-dissolved in hexane.

**612nm emitting QDs**

Indium acetate (0.1 mmol), myristic acid (0.54 mmol) and 8 ml of octadecene were added in
the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc
stearate (0.1 mmol) and 1-dodecanethiol (0.005 mmol) were added and heated to 230°C
(under inert Ar atmosphere). Following, tris(rimethylsilyl)phosphine (0.1 mmol in 1ml
octadecene) was injected into the hot solution at 230°C and waited 5 min at this temperature.
The solution was kept at 285°C for 10 min and then was cooled at room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room
temperature, and heated to 230°C under inert atmosphere. After 3 hours, 1-dodecanethiol (0.4
mmol in 1 ml octadecene) was injected by syringe pump (4ml/hour) into the flask and kept at
that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including
unreacted species of ligands and other precursors were removed by 5 ml hexane, centrifuging
at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20 ml
of acetone and 3ml methanol, then, centrifuged at 5000 rpm for 10 min, repeatedly. The final
product was re-dissolved in hexane.

**621nm emitting QDs**

Indium acetate (0.1 mmol), myristic acid (0.43 mmol) and 8 ml of octadecene were added in
the three necked flask, heated to 100°C and kept under vacuum for 1 hour. After cooling, zinc
stearate (0.1 mmol) and 1-dodecanethiol (0.005 mmol) were added and heated to 220°C (under inert Ar atmosphere). Following, tris(trimethylsilyl)phosphine (0.1 mmol in 1 mL octadecene) was injected into the hot solution at 220°C and kept 5 min at this temperature. The solution was kept at 285°C for 3.5 hours and then was cooled to room temperature.

For the shell coating process, zinc stearate (0.2 mmol) was added to the reaction flask at room temperature, and heated to 230°C under inert atmosphere. After 3 hours, 1-dodecanethiol (0.4 mmol in 1ml octadecene) was injected by syringe pump (4ml/hour) into the flask and kept at that temperature for 1 hour. Subsequent to cooling of the solution, the precipitate including unreacted species of ligands and other precursors were removed by 5 ml hexane, centrifuging at 5000 rpm for 10 min. In the next step, the supernatant solution was precipitated with 20 ml of acetone and 3 ml methanol, then, centrifuged at 5000 rpm for 10 min, repeatedly. The final product was re-dissolved in hexane.

**Full author names for references (4) and (8)**
