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To cite this version:

HAL Id: hal-03271347
https://hal.univ-lorraine.fr/hal-03271347
Submitted on 25 Jun 2021

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Fluorescent and water-dispersible ternary alloyed Cu- and Al-co-doped ZnSeS/ZnS QDs

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Abstract:
Fluorescent and water-dispersible ternary alloyed Cu- and Al-co-doped ZnSeS/ZnS QDs with pure dopant emission have been synthesized through a simple aqueous synthetic route using 3-mercaptopyrrolionic acid (3-MPA) as capping ligand (Figure 1). The influence of the Cu and Al-dopant concentrations has been systematically investigated in order to optimize the Cu-related photoluminescence (PL) emission. Through the increase of the dopants concentration, a significant increase of the PL quantum yield of Cu,Al:ZnSeS/ZnS QDs was observed (up to 30%). PL excitation and time-resolved PL measurements were also conducted to study the PL mechanism. The crystal structure and shape of Cu,Al:ZnSeS/ZnS core/shell QDs were investigated using XRD, TEM and HR-TEM. XRD reveals that QDs exhibit the zinc blende crystal structure. With the increase of the Al dopant concentration, a slight shift of the XRD peaks to small diffraction angle corresponding to the incorporation of Al³⁺ ions in the ZnSeS host was observed. TEM and HR-TEM results show that the nanocrystals have a spherical shape and a size around 2.8 nm. The composition of the QDs was also confirmed by XPS measurements. In addition, Cu,Al:ZnSeS/ZnS QDs exhibit a high photostability.

Keywords: Quantum Dots, Core/Shell, Photoluminescence, Co-Doping, Stability.