Nanochemistry and biotechnology

Gewald adducts as a new source of selenium in synthesis of $A^{II}B^{VI}$ luminescent nanoparticles

M.Y. Diakov, M.F. Prodanov, V.V. Vashchenko

Department of Technology of Organic Compounds, State Scientific Institution "Institute for Single Crystals", NAS of Ukraine, 60 Nauky Ave., Kharkiv, Ukraine
E-mail: diakovmaxim@gmail.com

Semiconductor nanoparticles (NPs) are one of the most promising materials for many applications including photonics, microelectronics, photovoltaics and bioluminescent imaging [1, 2]. However, currently used sources of selenium for synthesis of the NPs (CdSe, ZnSe *etc.*) of high performance, such as trialkylphosphine selenide, Se-ODE and selenoureas, have several significant drawbacks. In particular, the high toxicity, high cost and low stability of used Se precursors hamper the expansion of the existing synthetic protocols toward industrial scales. As an alternative to traditional Se precursors in the synthesis of NPs we offer derivatives of the selenophenes (Fig. 1) which can be obtained using "one-pot" Gewald reaction on the key step. Analysis of the thermogravimetric data has revealed the decomposition temperatures of compounds **1-3** to be equal to the typical temperatures of formation of $A^{II}B^{VI}$ type NPs (about 250-350 C).

The nanocrystals of two different shapes, namely quantum dots (QDs) and nanotetrapods were synthesized using compounds **1-3** as Se precursors. Particularly, QDs possessing blue and green luminescence with quantum efficiency up to 10% were obtained by reaction of **1** or **2** with cadmium stearate in presence of oleylamine as a capping agent. Further "one-pot" addition of S precursor to the seeds of CdSe results in formation of orange and red luminescent core-shell CdSe/ CdS nanoparticles with quantum yield reaching 15-20 %. The general patterns of influence of the Se precursors molecular structure and of the synthetic conditions on the NPs characteristics were explored.

Figure 1. Molecular structures of examined Se precursors.

1. Klimov V. K. Nanocrystal quantum dots. 2nd ed. // CRC Press.-2010.-453 p.
2. Ameenah Al-A. Quantum Dots - A Variety of New Applications // InTech.-2012.-290 p.