Nanocomposites and nanomaterials

Influence of nanosized SiO_2 and polyvinylpyrrolidone on luminescent properties of ZnO nanoparticles

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It was determined that adding SiO_2 nanoparticles to the reaction mixtures during the synthesis of ZnO nanocrystals leads to a significant change in luminescence intensity of nanosized zinc oxide. It was shown that the maximum luminescence intensity of ZnO nanoparticles, to which SiO_2 was added during the synthesis, is almost 3 times higher than in the maximum luminescence intensity of the original ZnO colloids. It was shown that the optimal concentration of silicon dioxide nanoparticles exists in which the luminescence intensity of ZnO nanoparticles reaches its maximum. Further increase of the amount of SiO_2 nanoparticles during the synthesis in the investigated range does not lead to any significant changes in luminescence of ZnO nanoparticles. Such significant increase of luminescence intensity of ZnO nanocrystals as a result of adding SiO_2 during the synthesis may be due to the uniform distribution of ZnO nanocrystals on the surface of SiO_2, which leads to the restriction of contact between the particles of the semiconductor and, consequently, reduces losses of photogenerated charges because of their migration between ZnO nanoparticles of different sizes.

It was determined that adding ZnO nanocrystals to polyvinylpyrrolidone (PVP) with a molecular mass of 360,000 g/mol results in the increase of the luminescence intensity of the initial polymer in the 350-450 nm region. Besides, broad luminescence band of zinc oxide nanoparticles appears with a maximum at 520 nm. The decrease of the molecular weight of the polymer to 40,000 g/mol leads to the significant decrease of the luminescence intensity of ZnO nanoparticles. However, at the same time, the luminescence intensity of the polymer increases. If the polymer with the molecular weight of 10,000 g/mol is used, the luminescence band of zinc oxide disappears completely. In this case, the intensity of the luminescence band of the polymer increases. Therefore, by changing the molecular weight of the polymer, it is possible to change the ratio of the intensities of the luminescence bands of PVP/ZnO films on purpose, which enables controlling the luminescence color of these compositions.