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Spectral characteristics of fine crystals ZnS-Ag depositioned from aqueous solution on a substrate in the electric field

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In this work, we studied the spectra of ultrafine ZnS–Ag particles deposited on a substrate from an aqueous solution in an electric field. To obtain fine particles, an industrial phosphor K-75 (ZnS–Ag) was used. The colloidal solution was kept in a test tube for several days until the water was completely transparent. After that, the solution from the top of the test tube was used for research. The emulsion was deposited on a stainless steel substrate or quartz glass plates, then the water was removed by evaporation. The temperature of the substrate, when water was removed, was maintained within the range of 60–65 ℃. This mode of evaporation makes it possible to more effectively remove water from the sample and, at the same time, does not contribute to the formation of convective flows that do not allow particles to be fixed in a certain position. Luminescence spectra were obtained by exposing the sample to ultraviolet light (λ = 365 nm). An analysis of the spectra showed that the spectral characteristics differ for samples with different crystal sizes. So for an industrial sample, the luminescence spectrum had a band with λ_{max} = 453 nm with a half-width $\Delta\lambda$ = 58.5 nm. For ultrafine ZnS–Ag crystals deposited in the usual way, the spectral band had λ_{max} = 452.4 nm with a half-width $\Delta\lambda$ = 58.0 nm. The photoluminescence spectra of samples, obtained by deposition of ultrafine ZnS–Ag crystals in an electric field on a substrate, have parameters with λ_{max} = 451.5 nm and with a half-width $\Delta\lambda$ = 57.6 nm. When measuring the band gap, the dependence of the band gap on the size of semiconductor crystals was established. The most noticeable effect was obtained when nanosized crystals were deposited on a substrate in an electric field. So for an industrial sample, the band gap was 4.06 eV, and for samples deposited in the usual way and in an electric field – 4.09 and 4.10 eV, respectively. The results obtained show that the band gap increases with a decrease in the size of crystals to nanoscale values. The polarization of light during the passage of a light beam through the samples also showed different results. Thus, the light beam passing through the sample from the initial material had the degree of polarization P = 0.094. For a sample obtained by deposition of nanoparticles in the usual way, the degree of polarization of the transmitted beam was P = 0.110. And for a sample prepared from fine ZnS–Ag particles deposited in an electric field, the degree of polarization of the transmitted light beam turned out to be P = 0.117. The results obtained show that materials obtained from fine particles by their deposition in an electric field have some differences in physical parameters.

Keywords: spectrum, ultrafine crystals, photoluminescence, electric field.

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