RELATIONSHIP WITH SELF-ORGANIZATION OF THE PHOTOLUMINESCENCE OF SOL-GEL PHOSPHOR

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Abstract.
The possibility of obtaining semiconductor dispersed particles of zinc sulfide doped with donor-acceptor impurities in the presence of the stabilizer - polyvinyl alcohol sol-gel method. The spectral optical properties and noted the high brightness of the photoluminescence of sol-gel phosphorus, obtained in the presence of the stabilizer. Mechanism of photoluminescence of dispersed sol-gel explained the electron-microscopic analysis method.

Key words: sol-gel method, zinc sulfide, donor-acceptor impurity, stabilizer, polydispersity, self-organization.

The given work is devoted reception disperse zol-gel of phosphors, to research of their optical properties and interrelation of these properties with character of self-organizing submicronic and nanoparticle a phosphor.
Synthesis of disperse zol-gels carried out in two stages. The first – preparation of solutions of the stabilizer – polyvinyl spirit (PVA) and acetates of salts of zinc and alloying additives, sodium sulfide. The second – carrying out of reaction of synthesis zol-gel of phosphors in solution PVS and without it. At draining of solutions in a certain order received disperse zol-gel phosphors.
PVA marks 16/1, the chemical formula $[-CH_2CH(OH)-]_n$ it is widely used as the stabilizer of zol-gels for reception of luminescent light sources, strengthening effect of influence of light [Akimov, Denisjuk and Bags, 1992].
Photoluminescence spectra removed on spectrofluorimeter AvaSpec-3648.
Lighting size – brightness of a photoluminescence measured by radio meter IL 1700.
Electronic spectra diffusions reflections (ESDR) samples received on Spectrophotometer Specord 200 (Analytik Jena AG, Germany) concerning the optical
The standard, Spectrplon analog MgO in a spectral working range of 200-900 nanometers.
The sizes, the form and color of formed disperse particles investigated a method of scanning electronic microscopy CamScan S490 FE and by means of an optical microscope.
Designations of samples disperse zol-gel of phosphors. Samples № 149 and № 143 - are received by an alloying of sulfide of zinc donorno-aktseptornymi impurity.
In the presence of PVA and without it, accordingly; samples № 148 and № 150 – are received.
Alloying of sulfide of zinc from one of investigated additives and without it, accordingly.
Spectra of a photoluminescence disperse zol-gel of phosphors are presented on fig. 1, and in the table values of width on half of height of a spectrum, brightness of a photoluminescence and luminescence elements Phosphors materials are resulted.

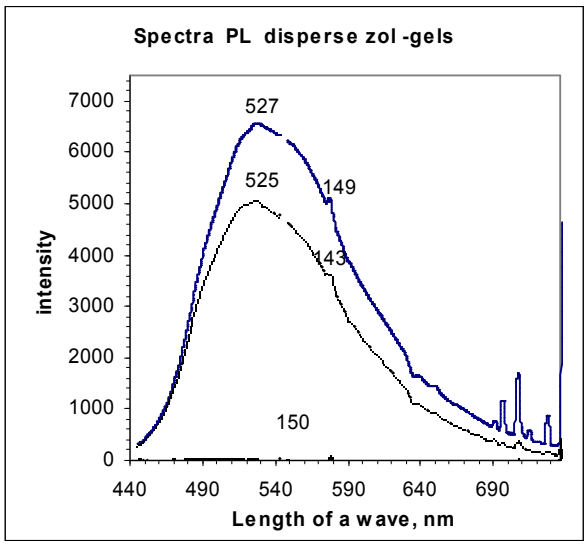


Fig. 1 – Spectra of a photoluminescence disperse zol-gel of phosphors samples № 143, № 149 and № 150.

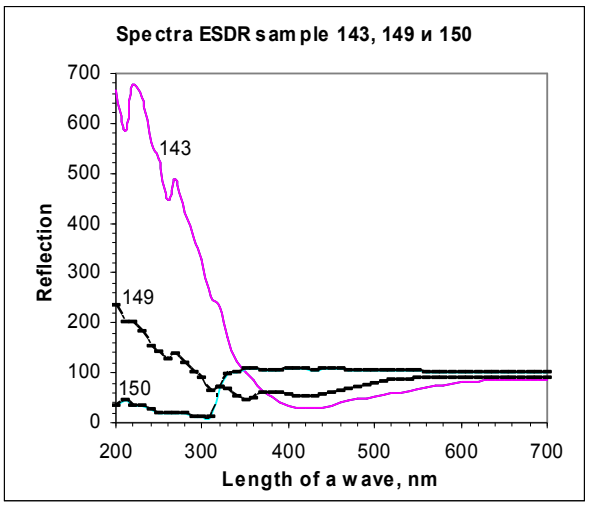


Fig. 2 - Electronic spectra diffusions reflections of investigated disperse samples of sulfide of zinc № 149, №143 both №150 in UV and visible areas of a spectrum.

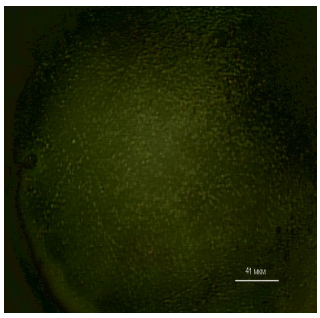
From fig.1 it is visible that photoluminescence spectra wide and are in all range of visible area. The maximum of an integrated luminescence corresponds to an interval of lengths of waves from 525 to 527 nanometers or energy of radiation ~ 2,35 эВ that corresponds to green color of a luminescence. The spectrum of a photoluminescence of the sample № 150 lies on axes of abscisses and brightness of a photoluminescence makes 0,5 kd/m^2. For investigated samples (kd/m^2) and semiwidth on half of height of a spectrum (nanometers) make 143 and 149 values of brightness of a photoluminescence: 18,6 and 112,5; 30,8 and 118,6, accordingly.

Luminescence elements: primesnye atoms and defects of a lattice, thin layers of water (№ 143); primesnye atoms and defects of a lattice, thin layers of the vodno-polymeric environment (№ 149); defects of a lattice (№ 150).

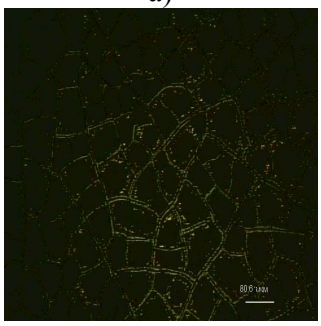
Spectra diffusions reflections corresponding disperse zol-gel of phosphors are resulted on fig. 2.

On spectra ESDR (fig. 2) it is visible changes of the form and position of edge of strong absorption and reflection of disperse samples that is caused by influence of the structurally-chemical factor of their surface. In near UV-area from 200 to 400 nanometers the short-wave part of optical electronic spectra as a result of transitions with carrying over of a charge which are shown in the form of intensive strips on the brink of visible and near UV - areas is formed. For the sample of sulfide of zinc (№ 150) own absorption with strip edge at length of a wave of 310 nanometers. For the alloyed samples №143 and № 149 stronger absorption for lack of the stabilizer isn'ted.

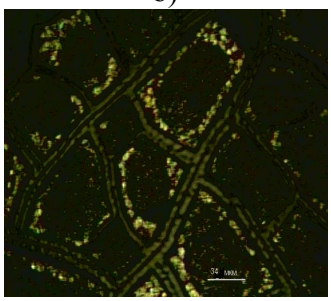
For the alloyed samples the difference in intensity and values of brightness can be caused different character of self-organizing наночастиц a phosphor in water and PVA solutions. At use PVA of a solution on a surface hemispherical drops in diameter 400-500 microns filled mainly with units of small fraction of a phosphor of a Fig. 3 and are formed.



a)



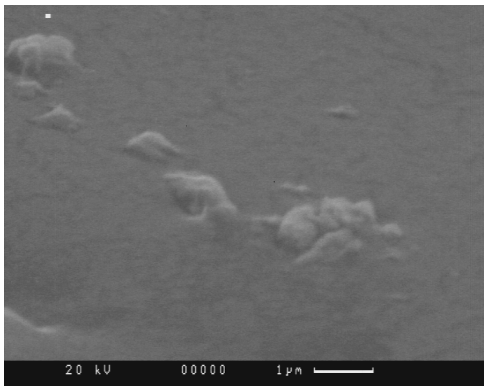
b)



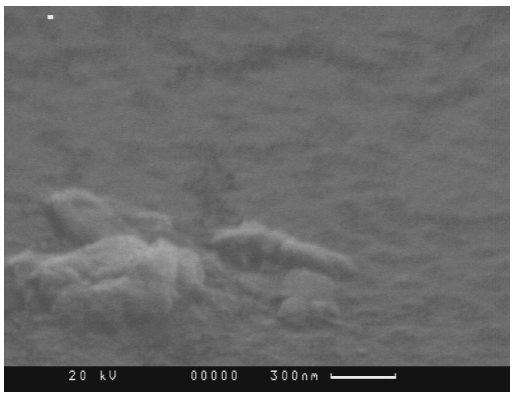
c)

Fig. 3. Images in an optical microscope of the alloyed phosphors placed in different environments: a) polyvinyl spirit; b) and c) water solution at two increases.

The sizes of this fraction by results of research in a scanning electronic microscope – 50-200 nanometers, and it basically is present at a kind of units of the micron sizes. At these units there are particles both with a strongly pronounced facet, and without it Fig. 4 a) and b).



a)



b)

Fig. 4. Images in a scanning electronic microscope of units smalldisperse phases of phosphors.

In water solutions (sample № 143) formations of such hemispheres it is not observed, in summary self-organizing the regular mesh-cellular structure is formed of the painted units of particles of colors greenish, white. Units of particles are located accurately on perimeter of cages and concluded in two ranks paths with the included molecules of water of a Fig. 3, c. Thus along with small fraction same as in a Fig. 4, there are particles of the micron sizes of a Fig. 3 c. And, the arrangement of particles of the different size has not casual character. The small fraction forms units in the form of Fig. paths 3b, and large particles settle down in cages 3c.

Conclusions

1. By a method of electronic microscopy it is shown that disperse samples synthesized zol-gel a method are polydisperse and aggregated.
2. The phenomena of self-organizing of polydisperse particles of a phosphor are observed. Character of self-organizing depends on Wednesday in which phosphors are placed. In polyvinyl spirit on a solution surface the hemispheres filled with units small nanosize of fraction of phosphors are formed.
3. The increase in intensity and brightness of a photoluminescence of sulfide of the zinc alloyed donorno-aktseptornymi by impurity and placed in a solution of polyvinyl spirit, is connected with formation of hemispheres on a surface.

Bibliography

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