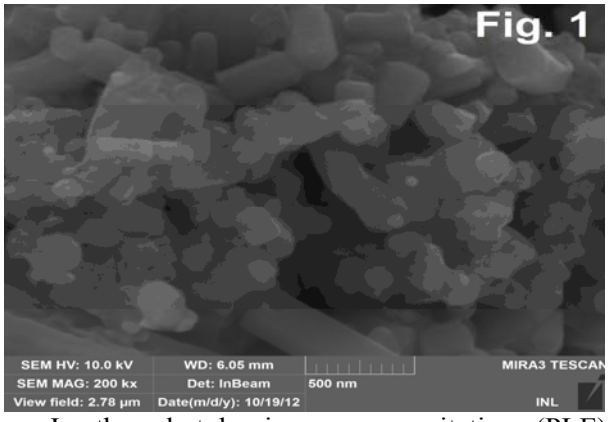
LUMINESCENT PROPERTIES OF FINE-DISPERSED ZnS:Cu PREPARED BY SELF-PROPAGATING HIGH-TEMPERATURE SYNTHESIS

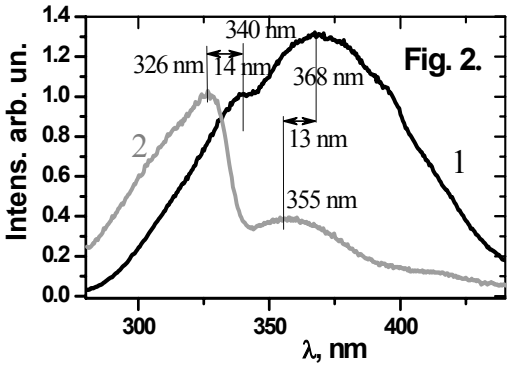
Yu. Bacherikov[1*], A. Zhuk[1], N. Semenenko[1], S. Zelensky[2], O. Krylova[2]
[1]V. Lashkaryov Institute of Semiconductor Physics, National Academy of Sciences of Ukraine, 41, av. Nauki, Kyiv 03028, Ukraine. *e-mail: Yuyu@isp.kiev.ua
[2] Taras Shevchenko National University of Kyiv, Faculty of Physics, 64/13 Volodymyrska Street, Kyiv, Ukraine, 01601

Among semiconductor phosphors which are commercially used, zinc sulfide ZnS has a special place. Possibilities of self-propagating high-temperature synthesis (SHS) for preparing ZnS-based phosphor materials are under extensive studying nowadays.

We studied the luminescence properties of ZnS:Cu, prepared by SHS. For preparing the fine-dispersed ZnS:Cu with SHS, Zn and S were taken in stoichiometric ratio, and the impurity concentration of Cu in the mixture was about 1 wt.%. As one can see in Fig.1 (SEM image), the synthesized fine-dispersed fraction is a set of particles of different sizes. It contains nanoparticles and also particles of micron and submicron sizes.



In the photoluminescence excitation (PLE) spectrum of bulk ZnS:Cu sample (Fig.2, curve 1) there are several peaks which can be attributed to band-band and impurity-defect luminescence excitation transitions. However, in the PLE spectrum of fine-dispersed fraction (curve 2) these lines are shifted towards short wavelengths. Such a shift can be interpreted as quantum size effects in the nanoparticles contained in the fine-dispersed fraction. The observed PLE shift value is in agreement with the appropriate shift of the PL spectrum. The observed shift values make ground for estimation of the average particle size as small as approximately 5 nm.



In the PLE spectum of fine-dispersed fraction of ZnS:Cu (curve 2 in Fig.2), spectral peak with λ_{max}~340 nm, which is typical for bulk ZnS, is almost absent. However, the SEM studies of fine-dispersed fractions show the presence of significant amount of particles of micron/submicron sizes, for which the quantum size effects are not relevant. Due to this fact it can be suggested that the absorption in quantum-sized particles dominates over the processes of absorption in the micro-particles in the SHS-prepared fractions. This suggestion requires further study in the future.

The above-presented results show that the SHS method is applicable for synthesis of ZnS:Cu phosphors with different content of nano - , meso -, and micro - particles, that allows to vary the luminescent properties.