METHOD FOR OBTAINING A MULTISPECTRAL GRADE OF ZINC SULFIDE

Ruslan V. Chkalov, 1 Kochuev A. Dmitriy, 1 Gerke N. Miron, 1 Darya G. Chkalova, 1
1 Vladimir State University named after Alexander and Nicolay Stoletovs,
Vladimir, Russia

Wide-gap semiconductors of the A2B6 type are traditionally used in the manufacture of IR optics. A special place in this group is occupied by zinc chalcogenides ZnSe and ZnS, due to the combination of unique properties, as well as the proven technology for obtaining these materials by chemical vapor deposition. It should be emphasized that the resulting CVD-ZnS is a polycrystalline material, the size of microcrystals (grains) of which is a parameter controlled within known limits, which varies during production. ZnS grown by traditional CVD technology has insufficient transparency in the visible range. The limitation of transmission in this case is due to the scattering of radiation by optical microsized inhomogeneities formed during growth in the polycrystalline CVD-ZnS FLIR-grade material.

For a number of applications, opacity in the short-wavelength part of the spectrum is unacceptable. It is possible to improve the properties of polycrystalline zinc sulfide during its subsequent processing by the method of high-temperature isostatic pressing (HIP - Hot Isostatic Press). As a result of such processing, a material with the highest possible transmission in the entire spectral range of 0.4 - 13.5 μm is obtained. At the same time, the mechanical strength properties of CVD-ZnS FLIR-grade are also improved, due to a decrease in the number of optical microsized inhomogeneities in the volume, and structure ordering. The resulting material is called CVD-ZnS MS grade (MS - MultiSpectral).

In the course of experimental work, 5 cycles of HIP processing of the CVD-ZnS FLIR-grade material were performed. In each cycle, 32 samples were loaded, packed in special equipment. At all stages of the experiment on HIP pressing, samples with a ground surface were used. The holding pressure was taken to be significantly lower than the maximum, since, according to the literature data, the use of the maximum pressure, other things being equal, gives a gain in quality of ~ 10%. Such a gain can be easily compensated by increasing the exposure time, and lowering the pressure can significantly reduce the cost of work and equipment wear.

When studying the effect of HIP pressing on the material being processed, the most important characteristic is the change in the light transmission of the sample in a wide spectral range. The figure 1 shows the course of the transmission curves for a sample of samples. Note that the obtained curves for the remaining samples are of a similar nature and differ in transmission by no more than 5%.

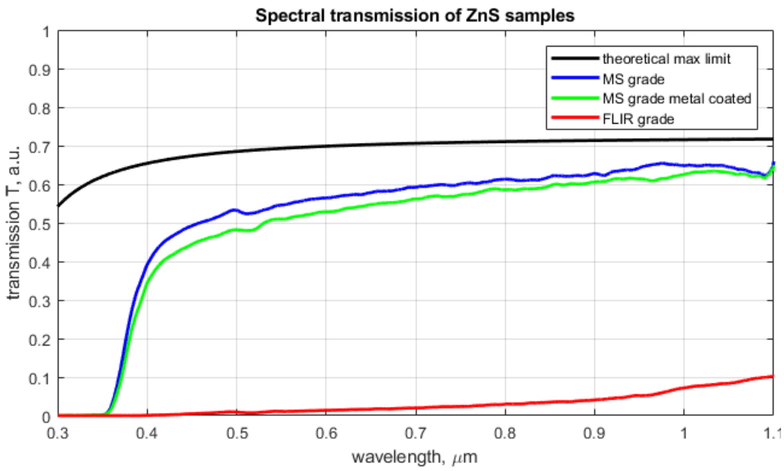

Figure 1 - Curves of samples spectral transmission.

It can be argued that the results of improving light transmission in a wide spectral range, obtained in the course of the work, correspond to commercial materials offered on the international market. The main goal of further research is to scale up the HIP technology for processing large-sized optical blanks.