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Defect formation regularities in ZnWO_4 and CdWO_4 crystals

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Structure of defects in ZnWO_4 and CdWO_4 single crystals (the latter being a model) is considered in detail depending on the main technology factors, namely, the raw material synthesis conditions and the crystallization regime from melt using the Chochralski technique. Characteristics of main macroscale defect types have been presented as well as the crystallographic features of their distribution over the crystal volume. A correlation has been found between the dislocations density distribution and the presence of macroscale structure defects.

Подробно проанализирована структура дефектов в монокристаллах ZnWO_4 и CdWO_4 (модельный объект) в зависимости от основных технологических факторов — условий синтеза исходного сырья и режимов кристаллизации из расплава по способу Чохральского. Приведены характеристики основных типов макродефектов, кристаллографических особенностей их распределения в объеме кристаллов. Установлена корреляция между распределением плотности дислокаций и наличием макродефектов структуры.

The long-term practice in growing of tungstate crystals allowed to conclude that the arise of structure defects is connected to a great extent with the presence of dissociating and volatile components in the melt [1–6]. Phase inclusions as scattering centers may be generated due to violations of temperature regimes defining the melt hydrodynamics. The interaction character of gas bubbles with the crystallization front is of great importance in the macroscale structure disordering processes. The solid and gaseous inclusions, linear defects and pores, residual mechanic stresses, and small-angle boundaries cause the quality deterioration of ZnWO_4 and CdWO_4 functional crystals. The regularities of macrodefects formation is to be stated also due to that microdefects

caused by similar technological factors are also present in the real crystal lattice. Such defects are discovered by more fine physical experimental methods. Their presence in the crystal lattice results in worsened scintillation characteristics of monoclinic tungstates ZnWO_4 and CdWO_4 [6].

ZnWO_4 and CdWO_4 single crystals of different structure perfection were grown by Czochralski technique (inductive heating, Pt crucible) using the industrial purity grade raw materials.

In extreme cases, the ZnWO_4 and CdWO_4 single crystals have been found to include a great number of macroscale structure defects forming rather dense region of poor transparency (Fig. 1). The shape of individual inclusions and their distribution in the