 

# The mechanism of light scattering centers' formation in sapphire crystals grown in gas atmospheres

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Presented in this paper are the results of investigation of the mechanism of light scattering centers formation in sapphire crystals grown by the horizontally oriented crystallization method in the protective gas atmospheres. The found regularities strongly differ from those which are observed at formation of other typical for sapphire crystals defects (vacancy pores, gas bubbles). That is why the known mechanisms of formation of macroscopic (≥ 1 μm) inclusions in crystals cannot be used in this case. For the description of the obtained regularities the authors propose to use the model of bulk crystallization.

Представлены результаты исследований механизма образования центров рассеяния света в кристаллах сапфира, выращенных методом горизонтальной направленной кристаллизации в защитных газовых средах. Установленные закономерности существенно отличаются от тех, которые наблюдаются при образовании других распространенных дефектов кристаллов сапфира (вакансионные поры, газовые пузырьки), поэтому известные механизмы образования в кристаллах включений макроскопических (≥ 1 мкм) размеров в данном случае не применимы. Для описания полученных закономерностей предлагается привлечь модель объемной кристаллизации.

The use of the protective (containing reducing components $H_2$, $CO$) gas atmospheres for growing sapphire by the horizontally oriented crystallization (HOC) method allowed to substitute expensive constructional materials (tungsten, molybdenum) for cheaper carbon graphite ones, to raise significantly the efficiency of the method and to bring it to the leading positions in the world market of big sapphire elements for mass application [1]. However violation of the melt stoichiometry in the process of its crystallization connected with the presence of the reducing component in the atmosphere leads under certain conditions to the formation of microparticles in crystals - light scattering centers from 1 to 5 μm in size [2, 3]. At high concentrations of such defects (higher than $10^5$ $cm^{-3}$) the material becomes ineligible for optical application.

Earlier on the bases of the experimental data and performed theoretical evaluations [4] it was supposed that there exists a "critical" for the $Al_2O_3$ lattice level of the stoichiometry violation exceeding of which can be a reason of a foreign phase microparticles precipitation. But there were no direct experimental data which would prove this supposition and would at the same time allow to evaluate the level of the "critical" concentration of oxygen vacancies.

Neither studied were size, form and distribution of particles which would allow to find out the origin of these objects and give an answer to the question whether they are formed in the melt and then are trapped by the crystallization front or their formation