DEFECTS IN MAGNESIUM ALUMINATES SPINEL CERAMICS

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Magnesium aluminates spinel, $MgAl_2O_4$, is currently a leading candidate for infrared missile domes applications because it has high hardness, strength, and chemical resistance. One of the most successful processes for production of optical quality spinel ceramics is hot-pressing technique of spinel powder doped with *LiF*. The variations of processing condition were applied to change of microstructure, porosity, optical and mechanical properties of spinel ceramics [1]. The Back Scattered Electron images of fractured surfaces of ceramics indicate that there exists variation of microstructure through the body of monolith. In this paper using optical spectroscopy we provide the investigations of the nature of point defects and their spatial distribution throughout the disk of transparent spinel ceramics doped with *LiF* up to 1.0 wt.% .

In pristine samples there were observed absorption bands at 4.75, 5.3, 5.65 and ~6 eV. By comparison with data on the spinel single crystals the first two absorption bands were identified with F^+- and *F*-centers, respectively [2]. Bands at 5.65 and ~6 eV were not observed in single crystals. Analysis of reaction between $MgAl_2O_4$ and *LiF* leads to conclusion on the formation of oxygen vacancies due to the incorporation of both *Li* and *F* ions into crystal lattice [1]:

$$3LiF \xrightarrow{MgAl_2O_4} (Li_{Mg})^- + 2(Li_{Al})^{2-} + 3(F_O)^+ + V_O^{2+}$$

The residual oxygen vacancies (V_O^{2+}) under different types of irradiation can capture one or two electrons forming F^+- or *F*-centers and corresponding absorption bands were observed. Other products of this reaction such as fluorine ions in oxygen site $(F_O)^+$ serve also as electron traps forming electron centers, which are responsible for the absorption band at 5.65 eV. Further, Li^+-ions are distributed on tetrahedral and octahedral cationic sites: Li^+-ions in Mg sites forming $(Li_{Mg})^-$ defects or in Al sites $(Li_{Al})^{2-}$ defects. The negatively charged defects capture holes and create the optically active centers which we have observed after irradiation. The correlation of variation of concentration of point defects and of microstructure with parameters of densification of transparent ceramics will be discussed.

References

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