Characterization of the defect structure in gadolinium orthovanadate single crystals grown by the Czochralski method

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Gadolinium orthovanadate ($GdVO_4$) belongs to the group of rare earth orthovanadates ($ReVO_4$), containing promising optical materials for laser and polarizer applications. These compounds may host some important ions responsible for laser phenomena. In particular the gadolinium orthovanadate is interesting as the material for diode-pumped solid-state lasers. Our former investigation of YVO_4 crystal, which belongs to the same group, were published elsewhere [1-2].

The lattice crystal structure of $GdVO_4$ single crystals undoped and doped with erbium or thulium was studied by means of X-ray diffraction topographic methods, exploring laboratory and synchrotron radiation sources. The synchrotron radiation experiments were carried out at the station F1 (white beam) at HASYLAB (DESY, Hamburg) in back reflection geometry. Conventional projection X-ray topographs were recorded in back reflection and in transmission geometry using $MoK_{\alpha 1}$ radiation.

The dominating imperfection of the investigated crystals was a variously developed block structure. It is generally caused by thermal stresses, but the development of this structure can also be moderated by some kinds of doping. The evaluation of lattice misorientation was performed by means of superimposed projection and section white beam synchrotron radiation topographs. In a case of extended block structure a series of Lang topographs with slightly angular settings was recorded. The evaluated misorientation between various blocks was in the range of several arc minutes.

The results revealed some changes between the samples cut out from different regions of the crystal. It was observed that the block structure is much more developed in samples cut out of the end part of the crystals. Some differences between differently doped crystals were also apparent. In particular the best perfection was observed in the crystal doped with thulium (4 at. %), where the mosaic structure was practically absent.

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References

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