GROWTH AND CHARACTERIZATION OF $ZnCr_2Se_4$ – SINGLE CRYSTALS DOPED WITH NEODYMIUM

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Transition metals chalcogenides with general formula AB_2X_4 (A and B are transition metals, X is a chalcogen element: O, S, Se, Te) are a very wide group of chemical compounds, having (possessing) a large spectrum of physical properties that make them very attractive to potential application [1]. The Cr-based selenospinels (ACr_2Se_4, A = Cd, Zn, Cu, Hg) possess interesting properties due to coexistence of frustration and strong coupling among spin, charge, orbital and lattice degrees of freedom. The $ZnCr_2Se_4$ matrix, belonging to family of spinel compounds, is a *p*-type semiconductor and antiferromagnet with normal spinel structure. The new $ZnCr_2Se_4$-single crystals doped with neodymium (0.05, 0.08 and 0.10) were obtained using chemical vapour transport method with anhydrous $CrCl_3$ as a transport agent, ZnSe and NdSe as a substrates. In order to determine the reaction conditions, the thermodynamic calculations were done. Analysis of the obtained $ZnCr_2Se_4$:Nd single crystals by X-ray diffraction, SEM and DSC/TG showed that these crystals are chemically pure, crystalline, occur in a cubic structure (SG: *Fd*3*m*) and thermally stable. The electrical and magnetic studies of neodymium doped $ZnCr_2Se_4$ – single crystals showed a semiconducting behavior, an antiferromagnetic (AFM) order and a short-range ferromagnetic (FM) interactions. Our results are generally in good agreement with our expectation. Neodymium ions had a stabilizing effect on both long-range AFM and short-range FM interactions, without spin frustration. However, the presence of neodymium ions having a large ion radius resulted in an increase in the Cr-Se bond lengths, leading to a significant reduction in short-range FM interactions compared to those of the bond lengths for the $ZnCr_2Se_4$ matrix. These crystals can have potentially application in magneto-electronic or magneto-optical switching devices.

References

1. L. Q. Yan, J. Shen, Y. X. Li, F. W. Wang, Z. W. Jiang, F. X. Hu, J. R. Sun, B. G. Shen, Appl. Phys. Lett. 90 (2007) 262502.