# Growing and Properties of $BiV_{(1-x)}Nb_xO_4$ Crystals

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Bismuth vanadate compound currently known due to its various applications. This is the pigment with excellent weather fastness and high opacity [1] and one of the most promising photoanodes for solar power devices [2] and super-ionic conductor [3]. Optical and acousto-optical properties of the material are not widely known. At the present time, single crystals with high birefringence ($\Delta n > 0.2$) are widely used in optoelectronic devices. One of the outstanding examples is a crystal of yttrium vanadate which has a number of unique physical properties such as high value of birefringence ($\Delta n = 0.204$), high hardness, wide transparency range (0.4 – 6 μm). All these features make yttrium vanadate crystals very attractive objects for optical components of fiber optic communication systems. In addition, these crystals doped with Nd-ions have other wide fields of application – they already are used as elements of solid state lasers. However, the technology of growing of $YVO_4$ is still far from perfect. The manufacturers of yttrium vanadate produce crystals which are suitable for commercial use. But the size of such crystals is quite small, not more than 2.5 centimetres in diameter.

Crystals of yttrium vanadate and bismuth vanadate belong to the same structural type $A^{3+}B^{5+}O_4$. In comparison with yttrium vanadate, bismuth vanadate has a much greater birefringence ($\Delta n = 0.45$ at $\lambda = 0.6$ μm), the optical transmission range 0.5 – 6.5 μm. At the same time bismuth vanadate has lower melting point 1210 K (in comparison with 2100 K of yttrium vanadate) and such has technological advantage over yttrium vanadate.

Bismuth vanadate has a structural phase transition at ~ 520 K. We have made an attempt to reduce the temperature of phase transition by creation $BiVO_4 – Nb_2O_5$ solid solutions. Crystals $BiV_{(1-x)}Nb_xO_4$ were grown by Czochralski method with x = 0.02, 0.04, 0.05, 0.08. Obtained crystals were 1 – 2.5 $cm^3$ in volume and of satisfactory optical quality. Optical transmission and temperature dependence of the dielectric permittivity were measured. It was observed that the phase transition temperature decreased with increase of niobium oxide concentration.

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[2] Yiseul Park, Kenneth J. McDonald, Kyoung-Shin Choi, Progress in Bismuth Vanadate photoanodes for use in solar water oxidation, *Chemical Society Reviews* **42** (2013) 2321.

[3] I. V. Golosovsky et al., Crystal structure and phase transition in the doped super-ionic conductor Bismuth vanadate $Bi_4(V,Fe)_2O_{11}$ revealed by neutron diffraction, *Physica Status Solidi B* **250** (2013) 1345.