o.m4.o5 Crystal growth and properties of $K_3Nb_3B_2O_{12}$ single crystals and their solid solutions. E.P. Kharitonova, V.I. Voronkova, and V.K. Yanovskii. *Department of Physics, Moscow State University, Moscow 119899, Russia.*
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The $K_3Nb_3B_2O_{12}$ (KNB) crystals attract attention as new materials with complex polymorphism and unusual combination of ferroelectric, antiferroelectric, ferroelastic and superionic properties.

The aim of present work is growth of KNB crystals and their solid solutions $K_3Nb_{3-y}Ta_yB_2O_{12}$ ($0 \le y \le 3$) and $K_{3-x}Na_xNb_3B_2O_{12}$ ($0 \le x \le 0.9$) and investigation of their phase transitions and physical properties.

Because of incongruent melting the studied crystals were grown with the use of flux method from the melts in the $K(Na)_2O$ - $Nb(Ta)_2O_5$ - B_2O_3 systems. They have sizes of about 1 cm and the faces of hexagonal prisms and pyramids of first and second types and pinacoid. Optical quality was high enough but could be markedly worse for the crystals with the large concentration of Ta. Additions of KF, KCl and WO_3 to the melt improve optical quality of the crystals but exert some influence on their refractive indices and phase transitions temperatures. Thus F, Cl and W ions can partially enter in the KNB crystal structure.

Investigations of the temperature dependencies of domain structure, dielectric permeability, electrical conductivity, nonlinear optical susceptibility show that the KNB single crystals undergo a complex sequence of phase transitions at 470, 400, 110, -85 and -97°C. Diffuse phase transition at 470°C seems to be antiferroelectric one whereas the phase transition at 110°C has ferroelectric nature and leads to appearance of spontaneous polarization along former hexagonal *c* axis. Other phase transitions are ferroelastic so the domain walls can be displaced under action of external mechanical stresses.

In Ta-doped crystals all the phase transitions became more diffuse and their temperature decreases. Partial substitution of K by Na decreases antiferroelectric phase transition temperature and increases that of ferroelectric transition.

Electrical conductivity of KNB single crystals is found to be mainly ionic and maximal along *c* axis with the value of about 10^{-5} $Ohm^{-1}cm^{-1}$ at the room temperature. It can be attributed to movable potassium ions which occupy the wide tunnels in KNB crystal structure. Some crystals exhibit sharp conductivity jumps near 400°C typical for superionic transitions. Partial substitution of K by Na further increases the conductivity value.

The results obtained show that KNB crystals and their solid solutions have unique combination of physical properties, can be regarded as representatives of a new kind of solid state materials: ferroelectrics - -superionics, and in this connection are of a great scientific interest.

Notes