3.12 Growth of Highly Conductive $KTaO_3$ Crystals

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Thin films of $KTa_{1-x}Nb_xO_3$ (KTN) on $KTaO_3$ (KT) substrates have many applications such as pyroelectric sensors and optical waveguides. To get the highest possible optical effects in the KTN films, the polarization should be reoriented to one common direction by applying an external electric field perpendicular to the film. This can be done only if the resistivity of the substrate is small compared to that of the film. As the resistivity of pure KT is around 10^{12} Ωm, we looked for a suitable dopant which would significantly reduce KT's resistivity. Barium, which has an ionic radius very close to that of potassium, was found to be an excellent choice.

Doped KT crystals were grown from a melt to which was added 175 ppm of barium. The size of the grown crystals was normally in the range of 1 cm^3. As-grown crystals were blue in appearance and remained unchanged after annealing in an oxygen atmosphere at 1220 K.

The resistivity was measured using a HP4192A impedance analyzer. The whole measurement control and data acquisition was done by a computer running software designed especially for the task. The resistivity was measured over a temperature range from 170 to 310 K and was found to be below 1 Ωm over the whole teperature range. The value remained unchanged also after annealing, which proves that the observed resistivity was not due to oxygen deficiency. To our knowledge, this is the lowest resistivity observed in this type of crystal achieved by intentional doping.