2.1 Growth of $KNbO_3$ Crystals with Different Dopants and Reduction Treatment

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Work with the aim of producing reduced $KNbO_3$ was continued. The difficulties encountered when growing crystals in a reducing atmosphere were overcome by limiting the gas treatment to the post-growth stage. A number of iron doped and pure $KNbO_3$ boules were grown in air and subjected to gas treatment in atmospheres of various oxygen partial pressures after they had been drawn from the melt. After a certain time these boules were cooled down with varying cooling rates while still immersed in the reducing atmosphere. The gas consisted of a mixture of CO and CO_2 where the mixing ratio defines the oxygen partial pressure at a given temperature.

It was found that for a given gas mixture the cooling rate plays a role in "freezing" the number of oxygen vacancies. A slow cooling rate allows the crystal to reoxidise as it is cooled. A fast cooling rate preserves the crystal in its high temperature state of reduction.

Optical samples are only available for part of the boules treated so far. From systematic optical, electrical and photorefractive measurements the trends indicated in our preliminary work last year are confirmed. Low oxygen partial pressures do indeed produce crystals where electrons are the dominant photoexcited charge carriers. A number of samples from boules grown during 1994 are in preparation.

Besides the efforts oriented in producing fast photorefractive $KNbO_3$, we are interested in extending the photorefractive response of $KNbO_3$ in the near infrared spectral range. We follow the approach that different dopants should be tried to induce the appropriate electron energy levels in $KNbO_3$. The levels should be excited with photons with energy lower than 2 eV (620 nm). Intentionally doped single crystals of $KNbO_3$ were grown in our laboratory. The top-seeded high-temperature solution growth method was used and the impurities were introduced in the melt in the form of Fe_2O_3, NiO, CuO, CeO_2, $KMnO_4$, and Co_3O_4 respectively. Different doping concentrations were tried with the goal of inducing an absorption coefficient of the order of 1 cm^{-1} while preserving good quality of the crystals. Large good quality strain free crystals were successfully grown in most cases after several adjustments of the melt composition. From the oriented boules, rectangularly shaped crystals were cut and oriented, and the faces normal to *a*– or *b*–axis were polished. The polished Fe doped crystals are yellowish in color, the Ni doped are dark green, the Cu doped are lightly gray, the Ce, Co, and Mn doped show light orange coloration.