FLAIR Colloquium

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**Zoom Link**

# Electro-acoustic Properties of Li(Nb,Ta)$O_3$ Solid Solutions at High Temperatures


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### Abstract

Lithium niobate-lithium tantalate (Li(Nb,Ta)$O_3$, LNT) solid solutions are used as model system to study the correlation of defect structure, electronic and ionic transport, and electromechanical properties in polar oxides. The work is embedded in the research unit FOR5044 *Periodic low-dimensional defect structures in polar oxides*.

Crucial high-temperature properties of LNT solid solutions such as bulk and domain wall conductivity as well as acoustic losses were determined as a function of temperature and oxygen partial pressure ($p_{O2}$) and correlated with the atomistic transport processes.

Above 400 °C, the acoustic losses are governed by the relaxation of piezoelectrically excited charge carriers and thus the electrical conductivity. Below this temperature, the losses decrease and reach values that correspond to that of phonon scattering. The electronic conductivity tends to be suppressed by high Ta contents, which becomes apparent above 600 °C and allows a reduction in losses. High mechanical resonance frequencies also lead to a reduction in losses, so that small structures or even thin films are desirable.

The $p_{O2}$ dependence of the conductivity can be explained by a defect mechanism that is not linked to the unwanted evaporation of $Li_2O$. Fundamental findings, such as the unexpectedly strong change in the activation energy of the electrical conductivity at the transition between the ferro-electric and paraelectric phase, are now also discussed.

Furthermore, domain wall currents at temperatures up to 400°C are determined and interpreted.

The LNT system is seen as the basis for the development of novel high-tech components for piezotronics, micro-actuators, integrated acoustics and photonics as well as quantum technologies even at high temperatures. The results can be transferred to other material systems such as multiferroics and perovskite-related materials.