# DF 2: Optical and nonlinear optical properties, photonic

Time: Monday 10:30–13:10 Location: GER 37

DF 2.1 Mon 10:30 GER 37

**Domain contrast in photoluminescence at Mg doped LiNbO3 and LiTaO3 single crystals** — •Philipp Reichenbach[1], Thomas Kämpfe[1], Andreas Thiessen[1], Mathias Schröder[1], Alexander Haussmann[1], Theo Woike[2], and Lukas M. Eng[1] — [1]Institut für Angewandte Photophysik, Technische Universität Dresden, George-Bähr-Str. 1, 01069 Dresden, Germany — [2]Institut für Strukturphysik, Technische Universität Dresden, Zellescher Weg 16, 01069 Dresden, Germany

We investigated multiphoton photoluminescence (PL) occurring in Mg doped $LiNbO_3$ (LNO) and $LiTaO_3$ (LTO) single crystals under a focused 100-fs laser beam at 790 nm. The PL signal always allows differentiating between switched domains and the virgin substrate due to the presence of a PL domain contrast of about 3% and 20% for the LNO and LTO substrates, respectively. This contrast shows a physical difference between original and switched state that originates from defect states in the crystals.
When annealing the sample above 100°C the domain contrast shows an exponential decay. Arrhenius plots of the decay times vs. the annealing temperatures show an activation energy of about 1 eV for both LNO and LTO. This value indicates that the contrast reduction is related with the motion of lithium or hydrogen within the crystal.

DF 2.2 Mon 10:50 GER 37

**THz Polarization Pulse Shaping by Birefringence in $LiInS_2$ Crystal** — •Qijun Liang[1], Shanpeng Wang[2], Xutang Tao[2], and Thomas Dekorsy[1] — [1]Department of Physics and Center for Applied Photonics, University of Konstanz, D-78457 Konstanz, Germany — [2]State Key Lab. of Crystal Materials, Shandong University, 250100 Jinan, China

The birefringence of $LiInS_2$ crystal in the THz frequency region is investigated by THz time-domain spectroscopy. $LiInS_2$ is a novel nonlinear biaxial crystal with high optical qualities such as large birefringence and low absorption in the THz frequency region. The optical properties of $LiInS_2$ are quantitatively determined. A pronounced sharp absorption caused by a TO-phonon resonance is observed at around 1.70 THz when $Z$-axis is parallel to the polarization of the incident THz wave. A temporal separation of the transmitted THz pulses with different polarization components is realized by changing the orientation of the $LiInS_2$ crystal with respect to the polarization of the incident THz pulses. By controlling the relative phase and amplitude of the temporally separated THz pulses, THz polarization pulse shaping caused by birefringence in $LiInS_2$ crystal is demonstrated.

DF 2.3 Mon 11:10 GER 37

**Optical Modes in Photonic Molecules from Whispering-Gallery-Mode Microcavities** — •Tobias Siegle[1], Sarah Wiegele[1], Carolin Klusmann[1], Tobias Grossmann[1,2], Tobias Wienhold[2], Uwe Bog[2], Sebastian Köber[2,3], and Heinz Kalt[1] — [1]Institute of Applied Physics, Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany — [2]Institute of Microstructure Technology, Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany — [3]Institute of Photonics and Quantum Electronics, Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany

Optical modes in photonic molecules consisting of microresonators are classified in analogy to quantum mechanics of chemical molecules. Closely approaching two microcavities leads to a photon exchange and subsequent formation of supermodes extending over the entire cavity system.

We used dye (pyrromethene 597)-doped polymeric microresonators to form active photonic molecules. To vary the inter-cavity gap and therefore the photon tunneling rate we developed a setup for flexible arrangement of two cavities, which must inevitably be substrate-overhanging after the manufacturing process. Spatially resolved spectroscopy of two coupled active microdisks and micorgoblets showed the localization of supermodes and a reduction of the number of lasing modes in size-mismatched cavities (Vernier effect) both proving efficient optical coupling.

DF 2.4 Mon 11:30 GER 37

**Boson peak in overdoped manganites** $La_{1-x}Ca_xMnO_3$ — •F. Fischgrabe[1], E. Zhukova[2,3,5], B Gorshunov[2,3,5], V. I. Torgashev[4], L. S. Kadyrov[2,3], E. A. Motovilova[2,3,5], T. Zhang[6], R. Kremer[7], U.S. Pracht[5], S. Zapf[5], V. V. Moshnyaga[1], and M. Dressel[5] — [1]I. Physikalisches Institut, Universität Göttingen, Germany — [2]A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, Russia — [3]Moscow Institute of Physics and Technology (State University), Russia — [4]Faculty of Physics, Southern Federal University, Russia — [5]1. Physikalisches Institut, Universitat Stuttgart, Germany — [6]Key Laboratory of Materials Physics, Institute of Solid State Physics, Chinese Academy of Sciences, PRC — [7]Max-Planck-Institut für Festkörperforschung, Germany

In the charge-ordered phase of strongly doped manganites $La_{1-x}Ca_xMnO_3(x \geq 0.5)$ absorption lines appear in the terahertz spectral range for commensurate x values right below the charge-ordering temperature. They are connected to acoustic phonons that become optically active by folding of the Brillouin zone. At lower temperatures a strongly asymmetric extra absorption band develops at frequencies corresponding to the position of the lowest-energy van Hove singularity in the reduced Brillouin zone. The band is assigned to the boson peak, i.e., to the excess of lattice vibrational states over the standard Debye contribution. The folded phonons and the boson peak do not show up for incommensurate calcium contents when no distinct Brillouin zone folding exists. Polycrystals are compared with freestanding films to determine if there are differences in the IR response.

DF 2.5 Mon 11:50 GER 37

**Optical phonons and dielectric properties of $LiNb_xTa_{(1-x)}O_3$** — •Michael Rüsing[1], Christopher Buchholz[1], Gerhard Berth[1,2], Huajin Zhang[3], and Artur Zrenner[1,2] — [1]Department Physik, Universität Paderborn, 33098 Paderborn, Germany — [2]Center for Optoelectronics and Photonics Paderborn (CeOPP), 33098 Paderborn, Germany — [3]State Key Lab of Crystal Materials, Shandong University, Jinan 250100, China

Recently Lithium-Niobate-Tantalate mixed crystals have drawn particular attention due to the possibility to tune the optical birefringence while sustaining its ferroelectric properties. A composition with zero birefringence at room temperature is of particular interest, as it represents an optical isotropic, but yet electrically polar material, which is unique in the class of ferroelectric materials.
Despite the unique properties only very few is known about the mixed crystals. Within this work Lithium-Niobate-Tantalate mixed crystals have been studied by polarization dependent $\mu$-Raman spectroscopy. Furthermore the dielectric properties have been characterized via the Lyddane-Sachs-Teller-Relation. Here, all phonon modes exhibit a Vegard-like behaviour. In contrast to recent theoretical work on mixed crystals some phonons show a nonlinear shifting-behaviour, while all around a linear behaviour has been suggested. This also affects the dielectric properties.

DF 2.6 Mon 12:10 GER 37

**Vibrational properties and directional dispersion of KTP** — •Peter Mackwitz[1], Michael Rüsing[1], Gerhard Berth[1,2], and Artur Zrenner[1,2] — [1]Department Physik, Universität Paderborn, 33098 Paderborn, Germany — [2]Center for Optoelectronics and Photonics Paderborn (CeOPP), 33098 Paderborn, Germany

Potassium titanyl phosphate (KTP) is a commonly used ferroelectric material with outstanding characteristics for applications in integrated optics. These properties include large electro-optical coefficients, high nonlinear coefficients and high damage threshold compared to other ferroelectrics. Particularly the spontaneous polarization enables the fabrication of periodically poled KTP (PPKTP) in order to achieve highly efficient frequency conversion processes by quasi phase-matching.
Although the material is commercially available a better understanding of its properties is inevitable for further advancement application of KTP. In this work polarization-dependent $\mu$-Raman-spectroscopy has been applied in order to study the vibrational properties of KTP. Furthermore the directional dispersion of the phonon modes has been recorded. Our measurements concur well with previous work on KTP. In detail we have assigned the most intense Raman-bands with fundamental vibrations in octahedral and tetrahedral molecules.

DF 2.7 Mon 12:30 GER 37

**Visualization of domain gratings in potassium titanyl phosphate by nonlinear microscopy** — •Moritz Grothe[1], Christopher Buchholz[1], Gerhard Berth[1,2], and Artur Zrenner[1,2] — [1]Department Physik, Universität Paderborn, 33098 Paderborn, Germany — [2]Center for Optoelectronics and Photonics Paderborn (CeOPP), 33098 Paderborn, Germany

The nonlinear microscopy combines the high spatial resolution of a confocal operating microscope with the additional information of polarization-dependent second harmonic generation allowing structure-adjusted characterization of the ferroelectric domain structure. In our study we address the nonlinear signatures of specific ferroelectric domain structures in potassium titanyl phosphate (KTP). Here the nonlinear response exhibit specific signatures, which are linked to the domain structure. A direct correlation with the nonlinear susceptibility tensor can be expected. A detailed nonlinear analysis of the transition area of contrarily poled domains reveals specific signal sequences subject to the polarity. Furthermore a functional dependence on depth of such se-quences was observed. Here an influence of surface charge and inner electric field distribution can be assumed.

DF 2.8 Mon 12:50 GER 37

**Determination of the nonlinear susceptibility of $LiNbO_3$-$LiTaO_3$ mixed crystals** — •Christopher Buchholz[1], Merlin Meise[1], Gerhard Berth[1,2], Huajin Zhang[3], and Artur Zrenner[1,2] — [1]Department Physik, Universität Paderborn, 33098 Paderborn, Germany — [2]Center for Optoelectronics and Photonics Paderborn (CeOPP), 33098 Paderborn, Germany — [3]State Key Lab of Crystal Materials, Shandong University, Jinan 250100, China

Varying the composition of mixed crystals allows for the tuning of their specific physical proper-ties. In this context Lithium niobate-tantalate (LNT), one of the simplest ferroelectric mixed crystals, is of particular interest due to its multifunctional characteristics. It shows piezoelectrical, particularly electrooptical and optical nonlinear effects. Furthermore the existence of a com-position with zero birefringence at room temperature is unique in ferroelectric nonlinear-optical materials. In particular we have analyzed the second-order nonlinear optical response for $LiNb_{(1-x)}Ta_xO_3$ over a wide composition range using nonlinear microscopy. The experimentally determined tensor coefficients of the nonlinear susceptibility for different compositions show a linear behavior. Here each tensor coefficient decreases linearly with increasing Ta content. The observed behavior was compered to theoretical calculations, whereby the measured values and those from literature are in good agreement.