KFM 3: Dielectric, Elastic and Electromechanical Properties

Time: Monday 12:00–13:00 Location: HSZ 105

KFM 3.1 Mon 12:00 HSZ 105

High sensitivity characterization of the nonlinear electric susceptibility of a glass ceramic in the microwave range — •Florian Bergmann[1,2,3], Martin Letz[1,2,3], Holger Maune[4], and Gerhard Jakob[1,3] — [1]Johannes Gutenberg Universität Mainz — [2]Schott AG Mainz — [3]MAINZ Graduate School — [4]TU Darmstadt

The 5G mobile communication standard aims to provide massive data rates to an increasing number of devices. This requires the use of higher frequencies and the efficient use of the available frequencies. A major challenge in the efficient use of frequencies is cross talk between channels due to passive intermodulation (PIM). One source of PIM can be the nonlinear electric susceptibility of dielectrics used in the devices. We characterized this nonlinearity of a glass ceramic. To achieve the necessary sensitivity for dielectric nonlinearities, the setup ensures that the measured intermodulation can be ascribed to the material under test while all other intermodulation sources are suppressed. The magnitude is comparable to previously measured high-end sintered ceramics. The power of the intermodulation signal as a function of the input power deviates from the simple 3 dB/dB scaling. This allows new insights into the polarization mechanisms of materials.

KFM 3.2 Mon 12:20 HSZ 105

Glass ceramics with magnetic crystalline phases for high frequency applications — •Moritz Maximilian Benjamin Krämer[1,2], Martin Letz[1], Martun Hovhannisyan[1], and Martin Jourdan[2] — [1]SCHOTT AG, Mainz, Germany — [2]Johannes Gutenberg University, Mainz, Germany

New generations of mobile data transmittance use higher frequencies to enable significantly higher data rates. The steady frequency increase and especially the step to 5G requires new manufacturing accuracies of high frequency electronic devices. For higher frequencies and smaller wavelengths the requirements to geometric tolerances and material homogeneity increase. Substantially higher accuracies are only accessible by better material homogeneity. Conventional ceramics have a restricted material homogeneity due to pores, thus a new glass ceramic obtained from a true amorphous glassy state possibly enables to reach new applications in the field of mobile data electronic devices. We investigate glass forming regions in the field of crystallization of ferrimagnetic phases. The talk will report on the latest progress in stabilizing the glass as a bulk sample of several cm in order to obtain controlled crystallization.

KFM 3.3 Mon 12:40 HSZ 105

Dilute metallicity in $SrTiO_{3-\delta}$ — •Thomas Schunk-Born[1], Christoph Grams[1], Kamran Behnia[2], and Joachim Hemberger[1] — [1]II. Physikalisches Institut, Universität zu Köln, Germany — [2]Laboratoire Physique et Etude de Matériaux (UMR 8213 CNRS-ESPCI), PSL Research University, Paris, France

Pristine $SrTiO_3$ shows comparatively high values of the dielectric constant ε' of ≈ 300 already at room temperature. When cooling the material, these values rise steeply, indicating the vicinity of a ferroelectric phase transition. In $SrTiO_3$, this transition is suppressed by quantum fluctuations, making the compound a quantum paraelectric with saturation values in ε' of the order of 10^4 [1].

While the parent compound is a wide-gap insulator, reduction of the oxygen content introduces free charge carriers in $SrTiO_{3-\delta}$. The result is a conducting and even superconducting material with unusually low charge carrier concentrations, made possible by the large effective Bohr radius caused by the high permittivity of the lattice [2].

While DC-data is available [3], we investigate the conductivity of $SrTiO_{3-\delta}$ depending on frequency and temperature using broadband dielectric spectroscopy. The Drude model is applied to this AC-data to retrieve scattering rate, mobility and effective mass of the charge carriers.

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[1] R. Viana *et al.*, Phys. Rev. B **50**, 601 (1994)
[2] X. Lin *et al.*, Phys. Rev. X **3**, 021002 (2013)
[3] C. Collignon *et al.*, Ann. Rev. Cond. Mat. Phys. **10**, 25-44 (2018)