DF 9 Phasenübergänge und Spektroskopie

Zeit: Dienstag 10:00–12:40 Raum: TU EMH225

Hauptvortrag DF 9.1 Di 10:00 TU EMH225

Size effects in BaTiO nanopowders and of BaTiO3 embedded in mesoporous materials — •Dieter Michel, Rolf Boettcher, Emre Erdem, Gert Klotzsche, and Winfried Boehlmann — Leipzig University, Institute of Experimental Physics II, Linnéstrasse 5, 04103 Leipzig

Studies of size effects on ferroelectric properties of oxide perovskites have obtained a great impetus in recent years. EPR and NMR methods can sensitively probe small changes of the local symmetry at the particular crystal sites and, thus, are sensitive to subtle structural short-range changes in nanocrystallites. The main field of this research is the application of multi-frequency EPR to the perovskitic nanocrystallites doped by 3d ions and of quadrupole distorted NMR. Ultrafine powders are prepared through combined-solid state polymerization and pyrolysis (CPP) /1-3/. The CPP prepared oxide perovskite nanopowders were characterized by various methods (TGA, DSC, FT-Raman, XRD, SEM and EDX). Moreover, the behavior of BaTiO3 embedded into mesoporous MCM 41 materials is studied. The lecture intends to give also a survey on recent studies in this field. References: /1/ R. Boettcher et al., 9th Cimtec-World Ceramics Congress, Ceramics: Getting into the 2000s, Part A (1999) 289-292. /2/ H. J. Glaesel et al., J. Mater. Sci. 34(1999)1-5. /3/ E. Erdem et al., J. Mater. Sci. 38 (2003) 3211-3217

DF 9.2 Di 10:40 TU EMH225

Lithium-Spin-Alignment-Echospektroskopie am Ionenleiter β-Spodumen — •Christoph Rier[1,2] und Roland Böhmer[1,2] — [1]Experimentelle Physik III, Fachbereich Physik, Universität Dortmund — [2]Interdisziplinäres Zentrum für magnetische Resonanz, IZMR, Universität Dortmund

Die Translationsdynamik des festen Alumosilikat-Ionenleiters β-Spodumen wurde mit Hilfe der stimulierten Lithium-Echospektroskopie, d.h. einem Kernresonanzverfahren untersucht [1], welches auf langsame Bewegungsprozesse empfindlich ist. In unserem Beitrag berichten wir über Versuche, rein quadrupolare Echospektren durch Variation von experimentellen Parametern wie beispielsweise den Pulslängen zu erhalten.

[1] F. Qi, C. Rier, R. Böhmer, W. Franke, P. Heitjans, Phys. Rev. B (eingereicht)

DF 9.3 Di 11:00 TU EMH225

Creep and relaxation dynamics of domain walls in periodically poled $KTiOPO_4$ — •Wolfgang Kleemann[1], Thomas Braun[1], Jan Dec[1,2], and Pamela A. Thomas[3] — [1]Angewandte Physik, Universität Duisburg-Essen, 47048 Duisburg — [2]Institute of Physics, University of Silesia, PL 40-480 Katowice, Poland — [3]Department of Physics, University of Warwick, Warwick, England

Creep and relaxation of domain walls under *ac* electric fields in an ideal model system, periodically-poled single-crystal $KTiOPO_4$, occurs in different regimes, which are separated by dynamic phase transitions at frequencies $f_m(T) = f_{m0}\exp(-\Delta E/k_BT)$ with $f_{m0} = 3{\cdot}10^9$ Hz and $\Delta E =$ 0.6 eV. Power law dispersion of the creep susceptibility, $\chi \propto 1 + (\mathrm{i}\,\omega\tau)^{-\beta}$ with $\beta \approx 0.4$, and large non-linearity encountered at $f < f_m$, is contrasted with Cole-Cole-type relaxational dispersion, $\chi \propto (1 + [\mathrm{i}\omega\tau]^{1-\alpha})^{-1}$ with $\alpha \approx 0.3$ at $f > f_m$.

DF 9.4 Di 11:20 TU EMH225

Magnetoelektrischer und anti-magnetoelektrischer Effekt in ferroelektrischen Manganiten — •M. Fiebig[1], Th. Lottermoser[1] und T. Lonkai[1,2,3] — [1]Max-Born-Institut, Max-Born-Straße 2a, 12489 Berlin — [2]Institut für Angewandte Physik, Universität Tübingen, Auf der Morgenstelle 10, 72076 Tübingen — [3]Hahn-Meitner-Institut, Glienicker Straße 100, 14109 Berlin

Die Verknüpfung dielektrischer und magnetischer Eigenschaften, die durch den magnetoelektrischen Effekt ($P = \alpha H$, $M = \alpha^* E$) zum Ausdruck gebracht wird, besitzt ein hohes anwendungstechnisches Potential, seit vor kurzem magnetisch geordnete Ferroelektrika als Quelle besonders großer ME Effekte erkannt wurden, mit deren Hilfe Phasenübergänge gesteuert werden können. Die mikroskopischen Prozesse dieser ME Kopplung sind jedoch noch weitgehend ungeklärt. Hier erläutern wir die mikroskopischen Ursachen ME Verhaltens in den magnetisch geordneten Ferroelektrika $RMnO_3$ (R = Sc, Y, In, Ho-Lu). Die ferroelektrische Verzerrung führt zu einer Modifikation der $R^{3+} - O^{2-} - Mn^{3+}$-Superaustauschpfade, was zu einer Änderung der freien Energie des Systems führt. Auch in den Manganiten, in denen der ME Effekt symmetriebedingt verboten ist, sind diese asymmetrischen Superaustauschprozesse aktiv. Da sich die mikroskopischen ME Beiträge somit lediglich in der Summe zu $\alpha = 0$ kompensieren, liegt hier *anti-magnetoelektrisches* Verhalten vor. Basierend auf diesen Ergebnissen formulieren wir allgemeine Kriterien für Substanzen, die kontrolliertes ME Schalten ermöglichen sollen.

DF 9.5 Di 11:40 TU EMH225

Non-linear and scaling properties of the dielectric response of $SrTi^{18}O_3$ in the quantum paraelectric regime — •Wolfgang Kleemann[1], Jan Dec[1,2], and Mitsuru Itoh[3] — [1]Angewandte Physik, Universität Duisburg-Essen, 47048 Duisburg, Germany — [2]Institute of Physics, University of Silesia, PL 40-007 Katowice, Poland — [3]Materials and Structures Laboratory, Tokyo Institute of Technology, 4259 Nagatsuta, Yokohama 226-853

Critical behavior, scaling and non-linear properties of the susceptibility $\chi = \chi$'- iχ" in ^{18}O isotope exchanged $SrTiO_3$ are revisited in a crystal, which was perfectly single domained by an external electric field in the quantum paraelectric regime above $T_c \approx 24$ K. Corrections due to random-field induced nanoregions turn out to be important, if not decisive, for a reliable description. We find quantum critical exponents $\gamma \approx 1.9{\pm}0.1$, $\delta \approx 2.7{\pm}0.1$ and $\Delta \approx 3.1{\pm}0.1$, and a cusplike behavior of the nonlinear coefficient B with an exponent $3\gamma{-}2\Delta \approx 0.4$. Below T_c the critical and scaling analysis is inhibited by large contributions of domain walls to the susceptibility.

DF 9.6 Di 12:00 TU EMH225

Dielectric response due to stochastic motion of pinned domain walls — •Andrei Fedorenko, Volkmar Mueller, and Semjon Stepanow — Martin-Luther-Universität Halle, Fachbereich Physik, D-06099

We study the contribution of stochastic motion of a domain wall to the dielectric AC susceptibility for low frequencies. Using the concept of waiting time distributions, which is related to the energy landscape of the domain wall in a disordered medium, we derive the power-law behavior of the complex susceptibility observed recently in some ferroelectrics below Curie temperature.

DF 9.7 Di 12:20 TU EMH225

Dielectric spectroscopy of $CuInP_2(S_xSe_1{-}x)_6$ (with x=0.4-0.95) layered crystals — •Juras Banys[1], Jan Macutkevic[1], Robertas Grigalaitis[1], Algirdas Brilingas[1], and Julian Vysochanskii[2] — [1]Departament of Radiophysics, Faculty of Physics, Vilnius University, Lithuania — [2]Institute of Solid State Physics and Chemistry of Uzhgorod University, Ukraine

The complex dielectric response of $CuInP_2(S_xSe_1 - x)_6$ crystals were investigated in the frequency range 20 Hz to 1.2 GHz. At low frequencies and high temperatures the dielectric spectra is mainly caused by high ionic conductivity. At higher frequencies and lower temperatures the dielectric spectra is caused by a broad distribution of relaxation times. The maximum of real and imaginary parts of dielectric permittivity shifts to the higher temperatures with increasing frequency. Obtained dielectric spectra were fitted with Cole-Cole formula and the mean relaxation time has been obtained. On cooling the Cole-Cole mean relaxation time strongly increase and distribution of relaxation times broaden. The temperature dependence of mean relaxation time was fitted with Fogel-Vulcher law. All features of the dielectric dispersion at low temperatures of present crystals are typical for the dipolar glasses. In the crystals with sulfur concentration x=0.95 ferroelectric phase transition has been observed together with the glass state at low temperatures.