SEMINARIUM Z MAGNETYZMU I NADPRZEWODNICTWA

Uprzejmie zawiadamiamy, że w **środę**

22 października 2014 r., o godz. 10:00

w sali 203 (bud. 1) odbędzie się seminarium, na którym

Prof. dr hab. Krystian Roleder

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wygłosi referat na temat:

Phase transitions and interrelated instabilities in antiferroelectric (non-polar) $PbZrO_3$ and $PbHfO_3$ perovskites

In spite of over 60 years that passed after the discovery of antiferroelectricity in oxidic perovskites ABO_3 we cannot say that we paid enough attention to the understanding of physical mechanisms leading to such non-polar state. $PbZrO_3$ and $PbHfO_3$ belong to *classical* aniferroelectrics. While the latter has been intensively studied for the last few years, the former one suffered, for long time, a lack of systematic investigations. Certainly, the most important reasons included a lack of good quality single crystals in large enough sizes.

Intense experimental investigations of these crystals have in fact proved that an antiferroelectric (non-polar) state in ABO_3 perovskites is not realized directly, but through a transient phase of polar (ferroelectric) properties spreading out a few degrees below T_C. It was explained by the strongly competing zone center and zone boundary instabilities being induced by strong anharmonic lattice. These two instabilities, i.e. a softening of the long wave transverse optic mode of almost displacive type, and accompanying softening of zone boundary related transverse acoustic mode were treated as an origin of precursor effects in a form of *local elastic perturbation of crystal lattice,* leading to the appearance of static (stable) micro/nanoregions of non-centrosymmetric symmetry above T_C. As a result, anomalous temperature dependence of the elastic stiffness coefficients has been observed above T_C [1], and the structure of the paraelectric phase could no longer be considered a pure paraelectric one [2].

Recent theoretical considerations have suggested that the antiferroelectric phase in $PbZrO_3$ can be treated as the *missing incommensurate phase* [3]. On the other hand, the experimental results proved that both crystals undergo first the phase transition to incommensurate and then to commensurate aniferroelectric state. It was just observed measuring temperature dependence of inelastic X-ray scattering [4] and of the birefringence in single $PbZrO_3$ (and $PbHfO_3$) crystals. It was interesting that in a part of crystal volume an ”intermediate/transient” phase could be observed as coexisting in a narrow temperature range with the antiferro- and paraelectric phases. This phenomenon seems to shed a new light on phase transition mechanisms in these *classical* antiferroelectric crystals. Namely, a role of internal strains produced by thermal gradients appearing during structural transition to low-temperature anitiferroelectric phase is considered to be the driving force for transient phase appearance. Temperature dependencies of dielectric and electromechanical properties, as well as elastic stiffness coefficients determined by Brillouin spectroscopy can be presented as supporting the new mechanism of antiferroelectric transition.

All the above would not be considered if there were no earlier investigations on the pre-transitional phenomena in ferroelectric $BaTiO_3$ [5], and aniferrodistortive $SrTiO_3$ [6]. While the stable (static) and non-centrosymmetric (birefringent) microregions were visible above T_C in $BaTiO_3$, which is entirely ferroelectric below T_C, considerably different behaviour was observed in $SrTiO_3$, in which precursor effects are referred to a long wavelength and zone boundary acoustic modes instabilities, and exist even 80K over the transition point, detected at 105K. In fact, the pre-transitional phenomena are present independently of the phase transition sequence evolving below T_C in oxidic perovskites.

[1] A. Bussmann-Holder, J-H. Ko, A. Majchrowski, M. Górny, K. Roleder, J. Phys.: Condens. Matter 25 212202 (2013), [2] N. Zhang, H. Yokota, A. M. Glazer, P. A. Thomas, Acta Cryst. B67 461–466 (2011), [3] A.K. Tagantsev. K. Vaideeswaran1, S.B. Vakhrushev, A.V. Filimonov, R.G. Burkovsky, A. Shaganov, D. Andronikova, A.I. Rudskoy, A.Q.R. Baron, H. Uchiyama, D. Chernyshov, A. Bosak, Z. Ujma, K. Roleder, A. Majchrowski, J.-H. Ko & N. Setter, Nature Communications, 4, No. 2229 (2013), [4] R. G. Burkovsky, A. K. Tagantsev, K. Vaideeswaran, N. Setter, S. B. Vakhrushev, A. V. Filimonov, A. Shaganov, D. Andronikova, A. I. Rudskoy, A. Q. R. Baron, H. Uchiyama, D. Chernyshov, Z. Ujma, K. Roleder, A. Majchrowski, and Jae-Hyeon Ko, Phys. Rev. B90 144301 (2014), [5] A. Ziębińska, D. Rytz, K. Szot, M. Górny, K. Roleder, J. Phys.: Condensed Matter 20 142202 (2008), [6] K. Roleder, A. Bussmann-Holder, M. Górny, K. Szot, A.M. Glazer, Phase Transitions 85, No.11 939–948 (2012)

Serdecznie zapraszamy

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