Contribution ID: **48** Type: **oral presentation**

Scaling of the dielectric response of supercooled disordered phases

Tuesday, 4 July 2017 13:00 (20 minutes)

Spectrum of a dielectric permittivity for supercooled disordered phases most often is composed of two relaxation processes [1]: a main relaxation process (called α process) followed by resolved, unresolved (also called 'excess wing phenomena'), or both secondary processes (β processes). Although there are many models describing dielectric relaxation [2-6] none of them describes the relaxation processes in supercooled disordered phases with a good precision, because of some simplifications introduced. Debye model [2] describes relaxation for non-interacting electric dipoles or electric dipoles in diluted non-polar medium whereas Debye-like models, i.e. Cole-Cole [3], Cole-Davidson [4], Havriliak-Negami [5], describe relaxation for non-interacting electric dipoles in viscous medium. Therefore, some scaling equations of the dielectric response were proposed [7-9] to describe molecular dynamics as a function of frequency of measuring field for various temperatures. However, they are limited to scaling of the imaginary part of dielectric permittivity only [7-9], and Nagel and co-authors model [7-8] refers in fact to systems with 'special'values of long-range and short-range correlation parameters of molecular interactions. Therefore, we have proposed a general form of scaling equation [10-11] that can be applied to the imaginary part of permittivity ϵ"(f) as well as to the real part of permittivity ϵ'(f)-ϵ_{∞}. The proposed scaling of the dielectric response applied to supercooled disordered phases, i.e. supercooled isotropic liquid phase and supercooled plastic-crystal phase, shows that behavior of resolved and/or unresolved β relaxations strictly depends on the parameters of the main relaxation process. One can conclude that the main relaxation process and the secondary ones are not independent processes.

References

[1] A. Kudlik et al., *J. Non-Cryst. Solids* **235-237** (1998) 406.

[2] F. Kremer, A. Söchnhals, *Broadband Dielectric Spectroscopy*, Springer-Verlag Berlin Heidelberg (2003).

[3] K. S. Cole, R. H. Cole, **J. Chem. Phys. 9** (1941) 341.

[4] D. W. Davidson, R. H. Cole, *J. Chem. Phys.* **18** (1951) 1417.

[5] S. Havriliak, C. A. Negami, *J. Polym. Sci. Part C* **14** (1966) 99.

[6] L. A. Dissado, R. M. Hill, *Proc. R. Soc. A* **390** (1983) 131.

[7] N. Menon, S. R. Nagel, *Phys. Rev. Lett.* **71** (1993) 4095.

[8] P. K. Dixon, L. Wu, S. R. Nagel, B. D. Williams, J. P. Carini, *Phys. Rev. Lett.* **65** (1990) 1108.

[9] Z. Dendzik, M. Paluch, Z. Gburski, J. Ziolo, *J. Phys.: Condens. Matt.* **9** (1997) L339.

[10] M. Gałązka, E. Juszyńska-Gałązka, N. Osiecka, M. Massalska-Arodź, A. Bąk, *J. Appl. Phys.* **118** (2015) 064101.

[11] M. Gałązka, E. Juszyńska-Gałązka, N. Osiecka, A. Bąk, *Phase Transitions* **89** (2016) 341.

Acknowledgments

Partial support by the 2014-2016 PAS-CNR bilateral project "Studies of phase polymorphism and dynamics in selected soft materials"and by the 2017-2019 PAS-CNR bilateral project "Multidisciplinary studies of structural and dynamic properties of glass-forming compounds"is acknowledged.

Primary author: Dr GALAZKA, Miroslaw (Institute of Nuclear Physics Polish Academy of Sciences)

Presenter: Dr GALAZKA, Miroslaw (Institute of Nuclear Physics Polish Academy of Sciences)

Session Classification: Soft Matter

Track Classification: Soft matter and glass formers