Summary of dissertation of Małgorzata Musiał MSc entitled:

„Acoustic and thermodynamic properties of ionic liquids – the influence of structure, temperature and pressure"

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The dissertation is devoted to the analysis of acoustic and thermodynamic properties of ionic liquids. The subject of the research are 30 aprotic ionic liquids differing in the structure of the cation and anion and the alkyl chain length in the cation, which is related to different acoustic and thermodynamic properties. The aim of the work is to find out the relationship between the structure of the ionic liquid, temperature, pressure, and the thermodynamic speed of sound; to determine the influence of the structure of ionic liquids, temperature and pressure on acoustic and thermodynamic properties; and the use of the acoustic method as a tool for searching new applications of ionic liquids.

In the theoretical part, the properties and applications of ionic liquids, the acoustic properties of the liquid phase (speed of sound, ultrasonic absorption and ultrasonic velocity dispersion) as well as the state of knowledge of acoustic properties and the high-pressure physicochemical properties of ionic liquids were presented.

In the experimental part, the samples and measurement methods (speed of sound, density, isobaric heat capacity, viscosity, surface tension, contact angles, cytotoxicity and electrical conductivity) were characterized as well as the obtained experimental results were presented. The temperature and pressure dependence of Gibbsian properties (density, isobaric heat capacity, isothermal compressibility, isobaric thermal expansion) as well as non-Gibbsian properties (isentropic compressibility, isochoric heat capacity, internal pressure) were determined using the high-pressure speed of sound together with density and molar isobaric heat capacity at atmospheric pressure by the acoustic method. Based on the experimental high-pressure electrical conductivity, the high-pressure viscosity was determined, which allowed to determine the classical absorption under high-pressures.

Based on the result obtained in this work, it was shown that the transition between globular microphases and sponge-like morphologies is reflected in the dependence of speed of sound and surface enthalpy on the length of the carbon chain in the cation.

It was proved that the minimum of the speed of sound dependence on the alkyl chain length in the cation $u(n)$ is directly related to the large, weakly coordinating anion $[NTf_2]^-$ by comparing the series of bis(trifluoromethylsulfonyl)imides with 1-alkyl-3-methylimidazolium cation ($[C_nC_1im][NTf_2]$), 1-alkyl-1-methylpyrrolidinium cation ($[C_nC_1pyr][NTf_2]$), *N*-alkylpyridinium cation ($[C_npy][NTf_2]$), with the series of 1-alkyl-3-methylimidazolium trifluoromethylsulfonate ($[C_nC_1im][TFO]$). It was shown that the minimum of the $u(n)$ dependence was shifted to a lower alkyl chain in the cation with increasing pressure. This behavior may be related to the increasing cohesive energy with pressure. It was shown that pressure-temperature dependence of internal pressure is related to the structure of ionic liquids and the nature of intermolecular interactions, and the similarities between molecular liquids and ionic liquids have been found. Moreover, new applications of selected ionic liquids as potential heat transfer media and hydraulic fluids have been found.