Electrical transport in Li2O-P2O5-GeO2 glass-ceramics

Kristina Sklepić[1], Luka Pavic[1], Zeljko Skoko[2], Gregory Tricot[3], Petr Mosner[4], Ladislav Koudelka[4], and Andrea Mogus-Milankovic*†[1]

[1]Ruder Boskovic Institute (RBI) – Croatia

[2]Department of Physics, Faculty of Science, University of Zagreb (PMF) – Croatia

[3]Unité de Catalyse et Chimie du Solide, Universite de Lille1, 59655 Villeneuve d'Ascq – université de lille1 – France

[4]Department of General and Inorganic Chemistry, Faculty of Chemical Technology, University of Pardubice,53210 Pardubice – Czech Republic

Abstract

Mixed glass former system with the composition 40Li2O-(60-x)P2O5- xGeO2, x = 0-25 mol% was chosen for the investigation of the effect of induced crystallization on electrical properties. Gradual addition of GeO2 units into phosphate chains causes a depolymerisation which leads to facilitated Li+ ions mobility. Therefore, our interest was to investigate how various steps of crystallization influence the electrical transport in these glasses. Electrical properties of glass-ceramics have been studied using impedance spectroscopy and correlated with the results of structural analysis. Heat-treated glasses have been characterized by XRD, MAS NMR and SEM. With increasing GeO2 content from single to multi crystalline phase glass-ceramics were formed. For GeO2-free glass-ceramic a slight increase in the electrical conductivity was evidenced whereas a conductivity decrease for glass-ceramics containing up to 20 mol% of GeO2 is related to the reduction of number of Li+ ions in residual glass matrix since the LiPO3 crystalline phase was formed. The crystallization in the glass-ceramics with higher GeO2 content causes an increase in the electrical conductivity due to formation of crystallites with well-defined shapes, which pronounces easy conduction pathways for Li+ ions transport within crystalline grains and along crystalline grain boundaries. The contribution of grains and grain boundaries to the total electrical transport in these polycrystalline glass-ceramics is discussed in detail.

Keywords: Germanate glasses, Elelctrical properties, Glass ceramics

*Speaker

†Corresponding author: Andrea.Mogus.Milankovic@irb.hr