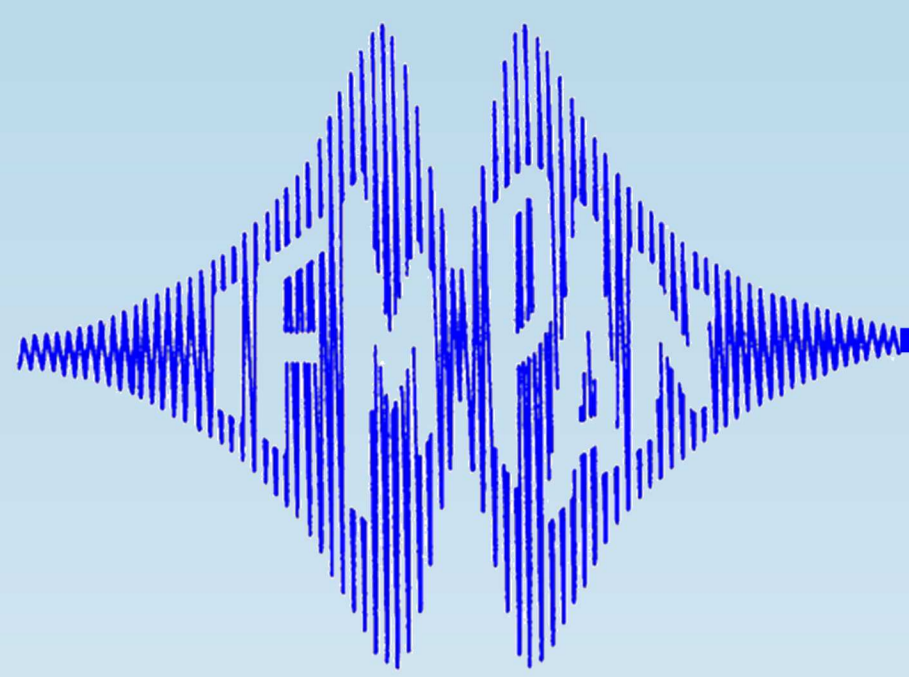


Low molecular weight organic gelators as a hardener for gel electrolytes.

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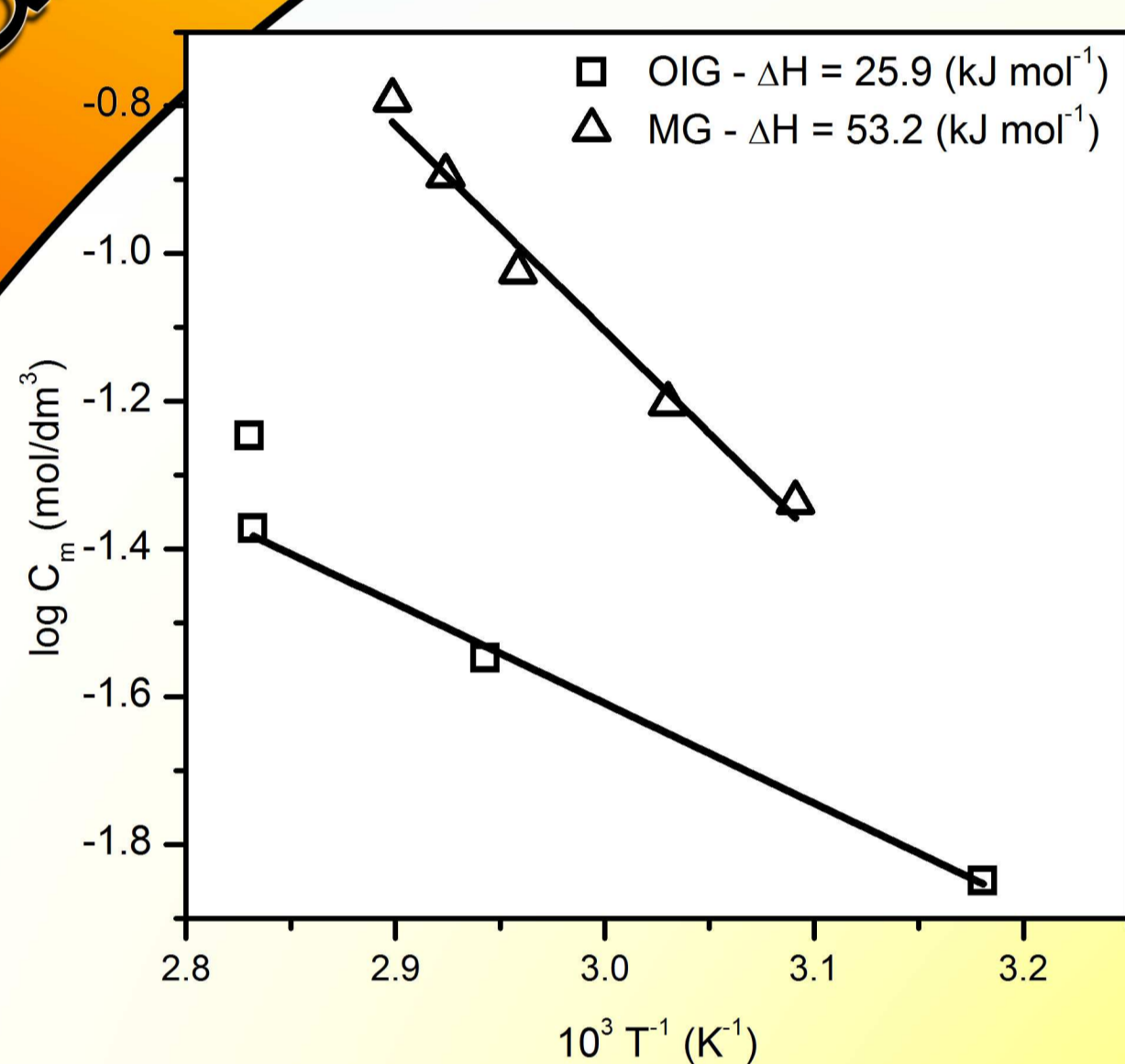
Introduction

The electrolytes and ionic liquids acting as ionic conductors are important elements of batteries, supercapacitors and fuel cells in a variety of electrical devices. However, such systems based on liquid phase shows many undesirable properties such as the possibility of leakage, evaporation, and corrosion. On the other hand, the solid-state electrolytes are characterized by no leak, non-volatility, mechanical strength and processing flexibility but unfortunately, also by low conductivity caused by their immobile matrix and because of that, their use has been limited. Therefore, gel electrolytes have been invented to combine high conductivity of liquid electrolytes with the advantages of solid electrolytes. Depending on the nature of gelator, gel electrolytes can be classified into gelled polymer electrolytes (GPE) and organic ionic gels (OIG) based on low molecular weight gelators (LMWGs). The former are in most of the cases the chemical gels formed as a result of polymerization reactions and chemical bonding. The latter ones are always physical gels formed by the self-assembly of gelator molecules in solution of electrolytes or ionic liquids, through the non-covalent intermolecular interactions such as hydrogen bonding, π - π stacking, van der Waals and electrostatic interactions, coordination, or charge transfer.

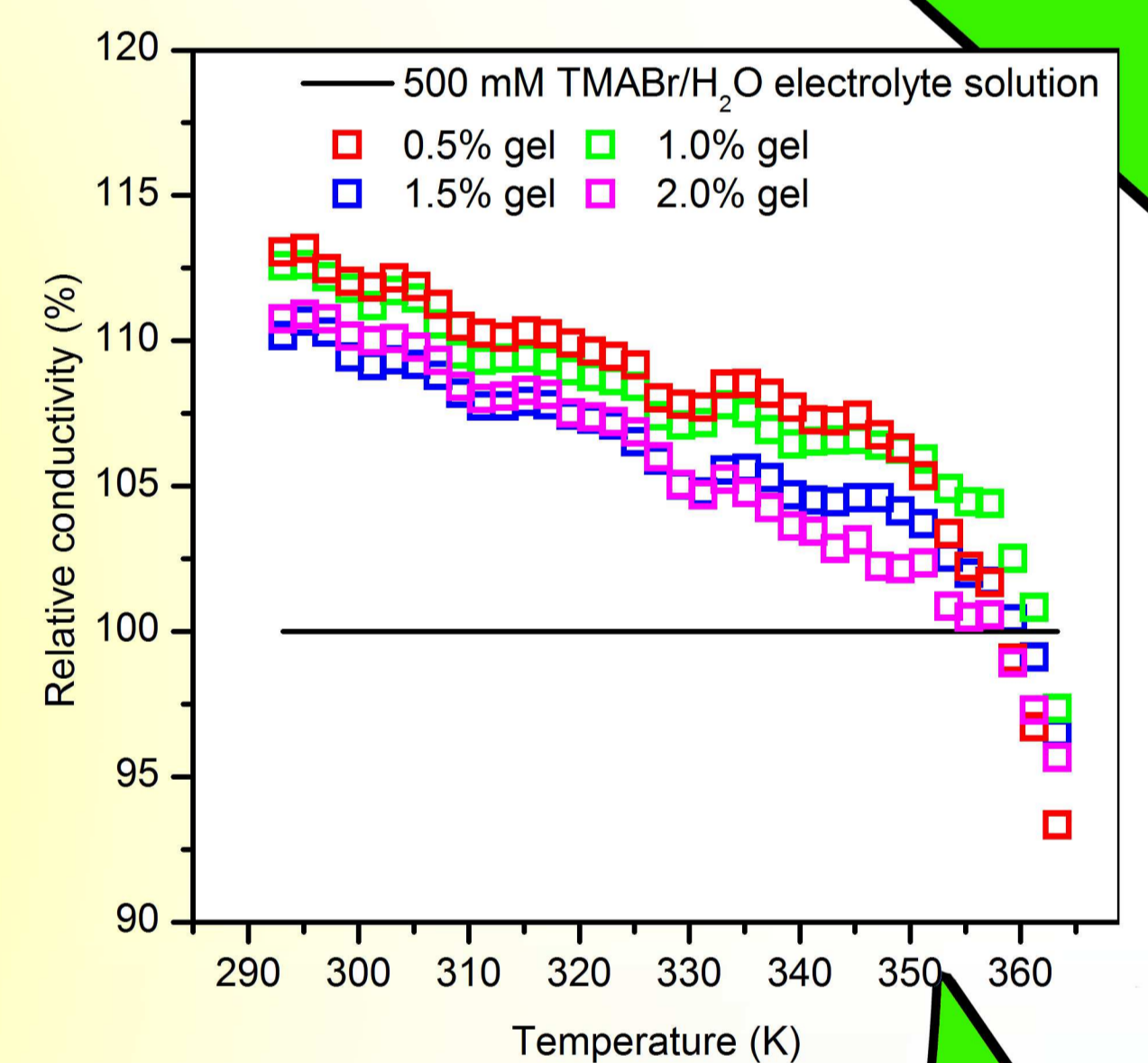
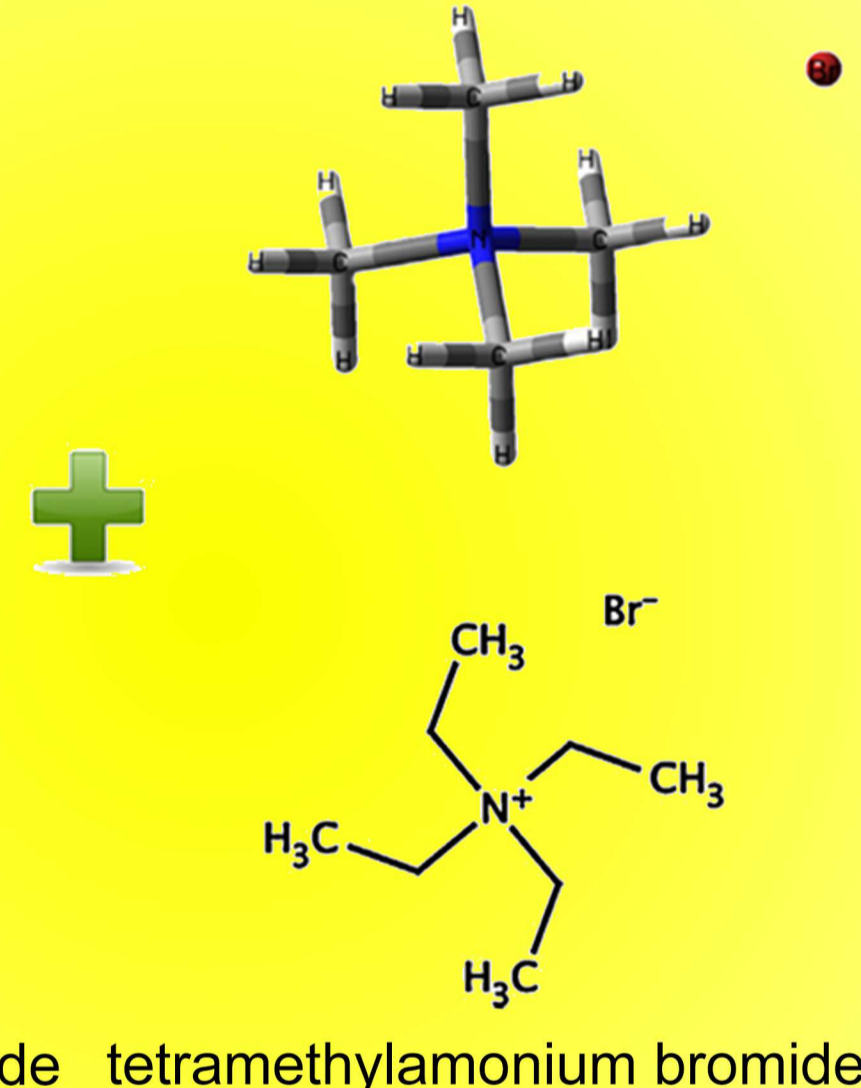
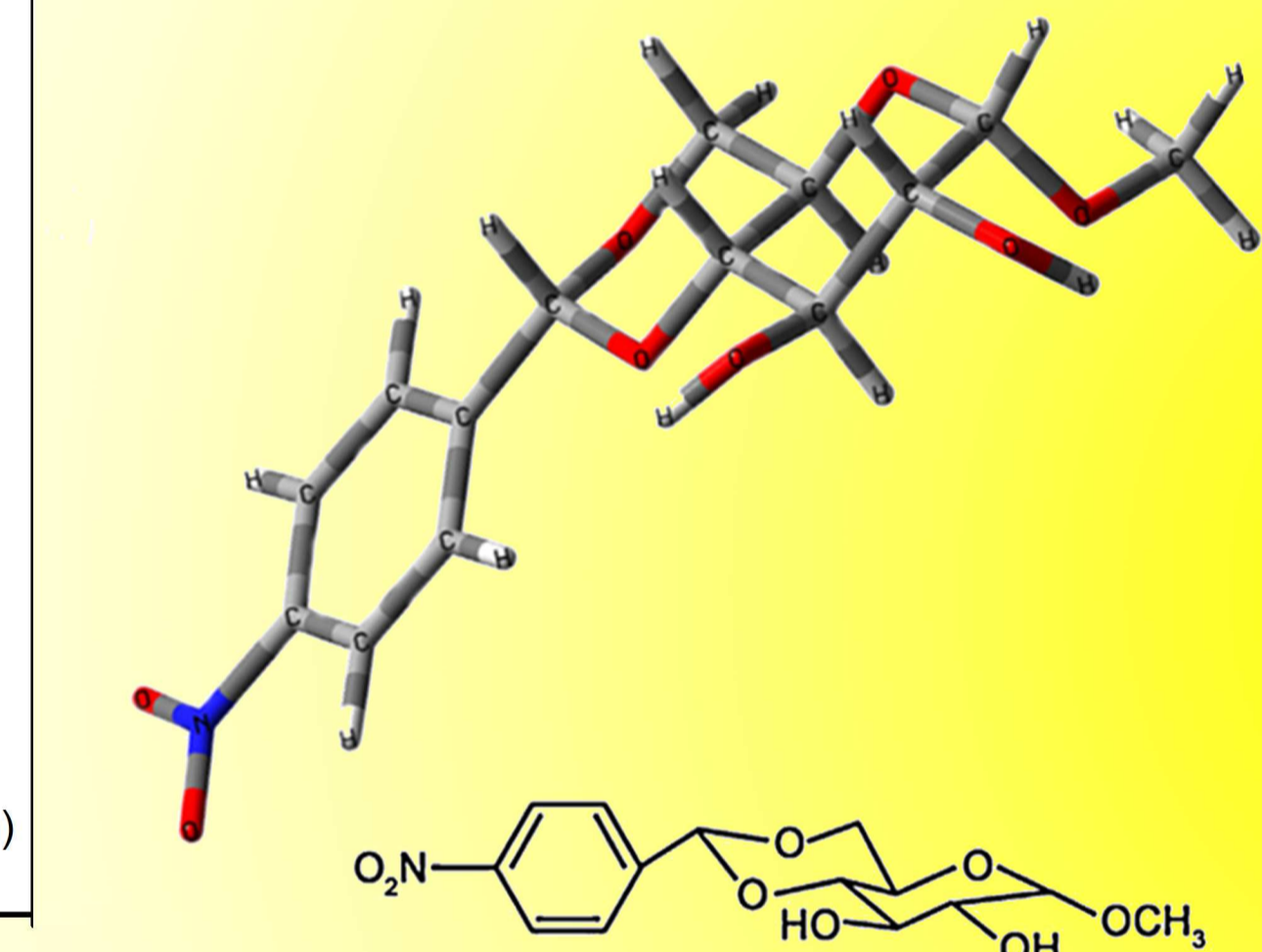
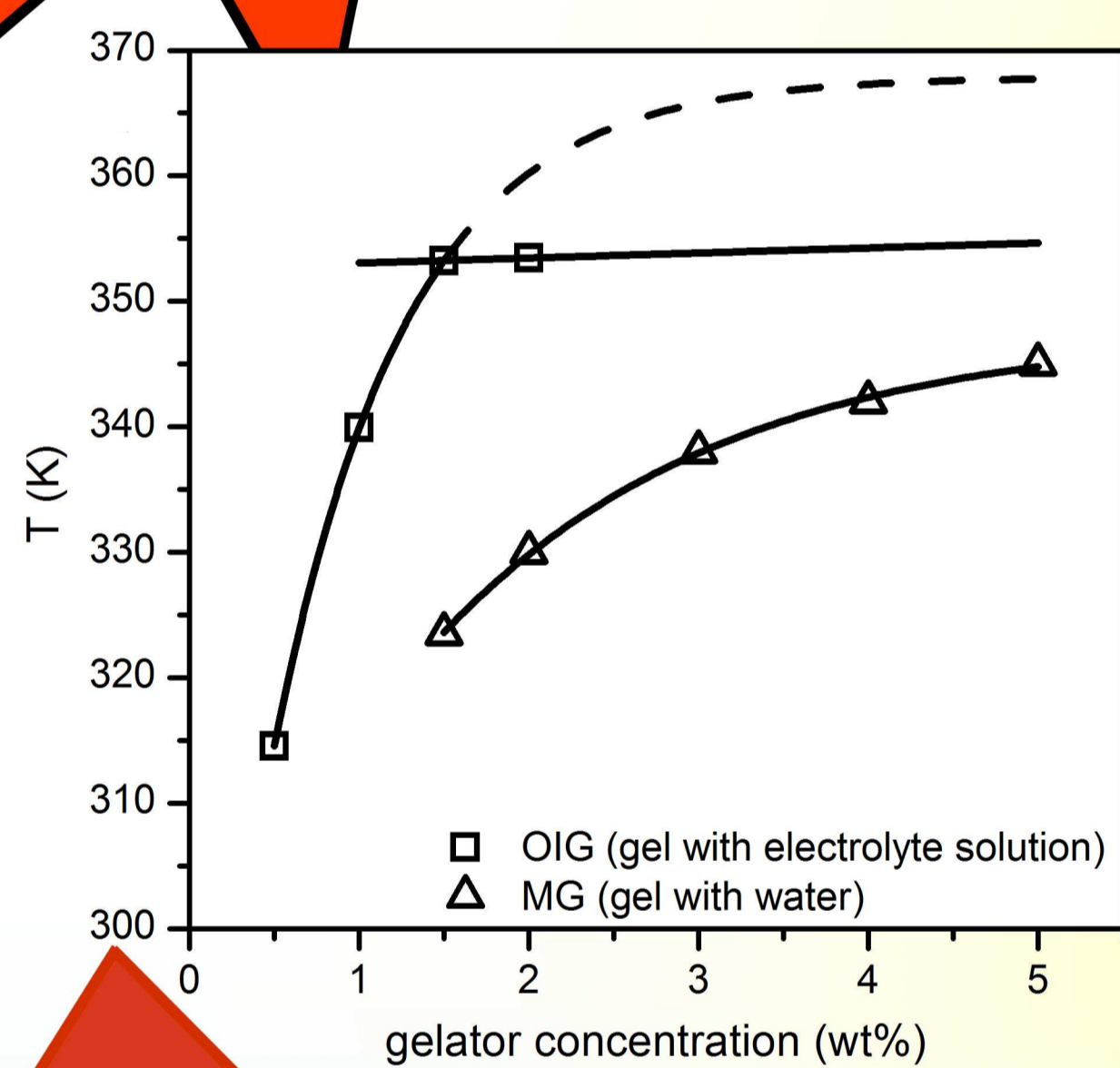
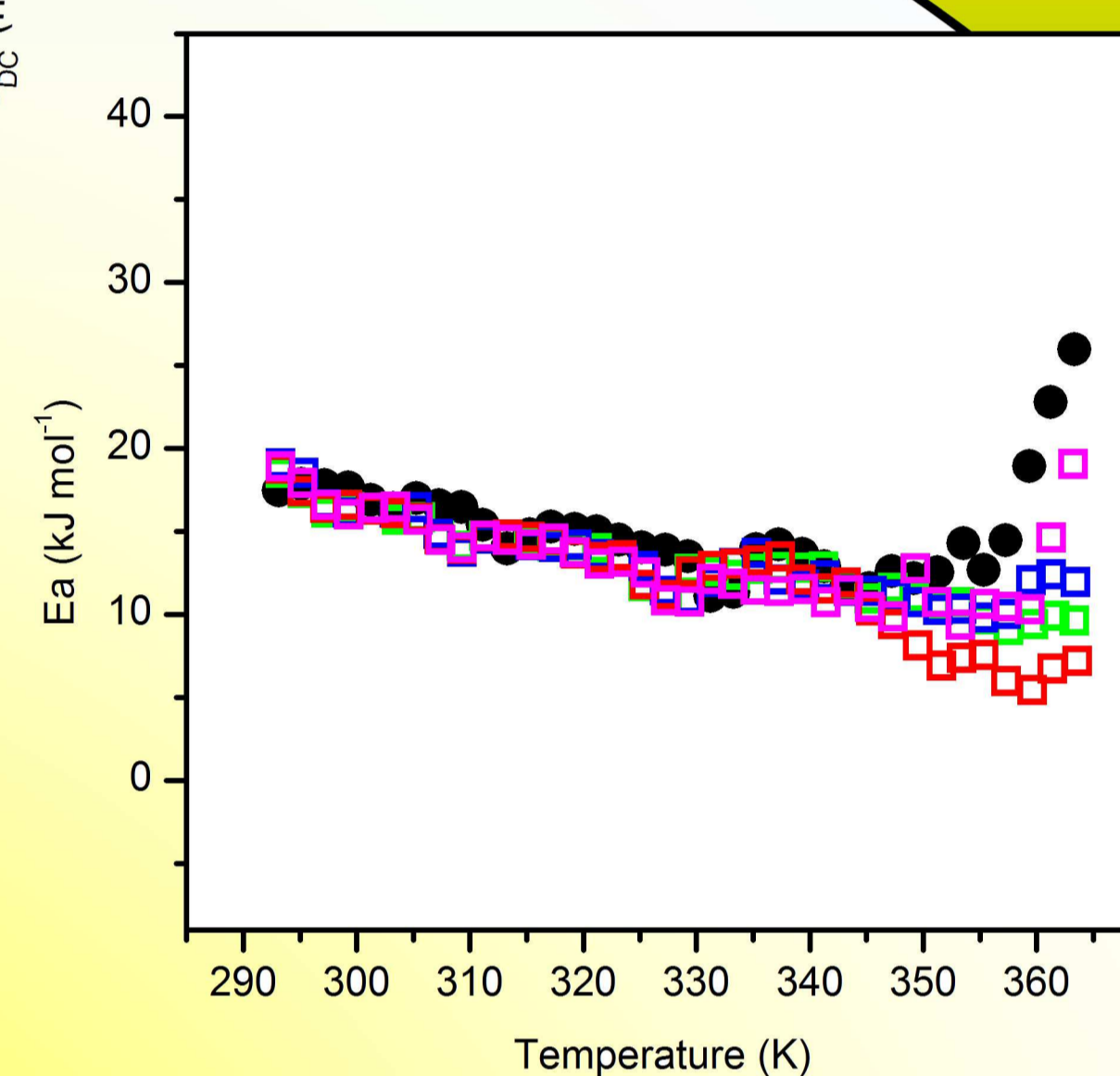
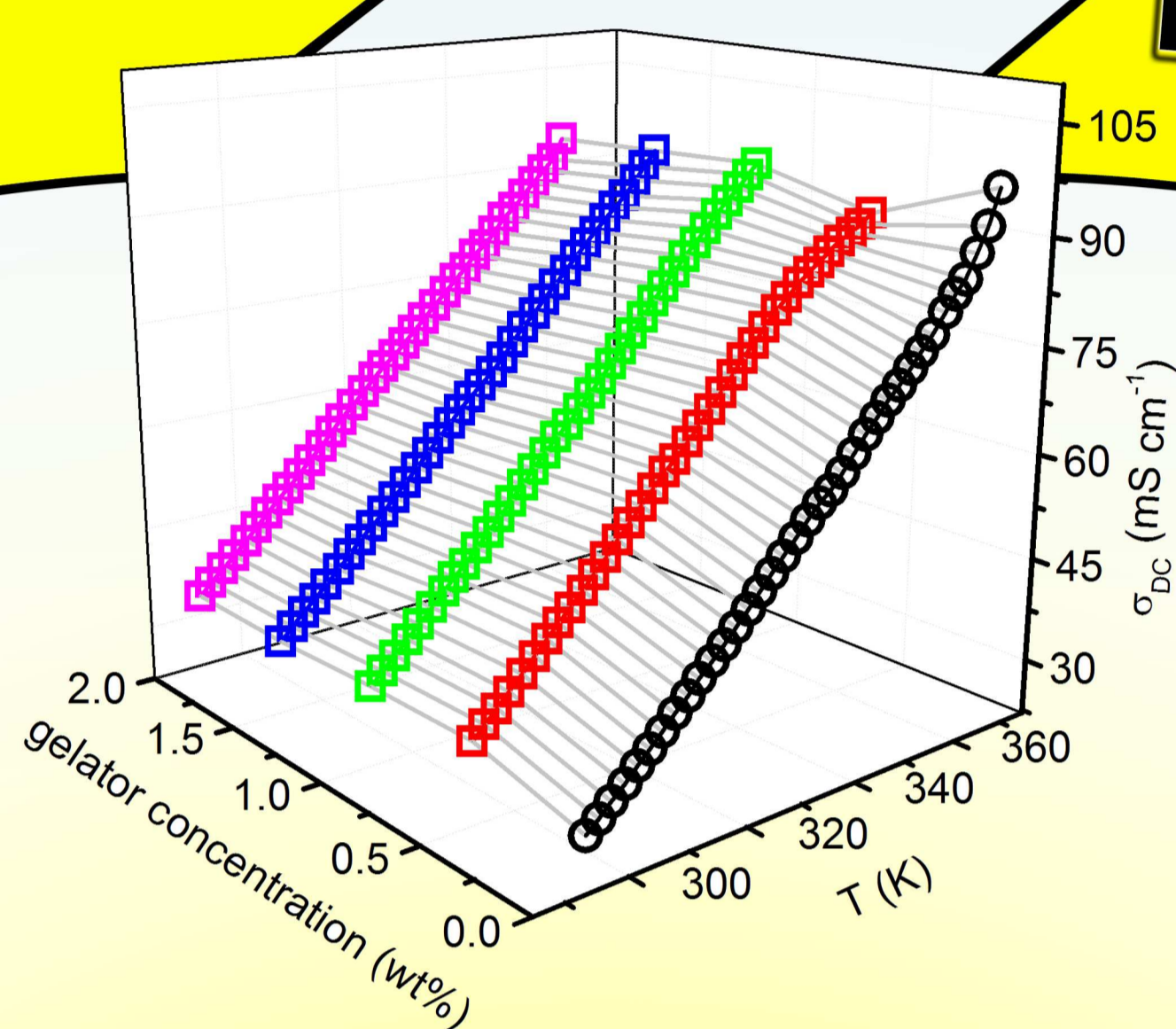
Aim of the study

The big trend in modern electronics for lighter, more powerful and versatile mobile smart devices requires power sources of higher capacity, nonregular shape, lighter form and longer cycle life time. Our experiences with physical gels, system which are capable to immobilize huge amounts of liquids and are thermoreversible thus can be renewed and reformed by appropriate thermal treating, encourage us to try to create electrolyte gel system which can be thermal reversible and thus can be restored to its primary form whenever it becomes damaged. In this way one could create system which would heal itself if needed and thus the cycle life of power source could be largely extended. In this paper, we report on the studies of a low molecular weight gel electrolyte formed by self-assembly of methyl-4,6-O-(p-nitrobenzylidene)- α -D-glucopyranoside (1) in the tetramethylammonium bromide (TMABr) aqueous solution. A gel electrolyte was prepared with gelator (1) and 500 mM TMABr aqueous solution. The sol-gel technique was used to obtain gel samples at 0.5%, 1.0%, 1.5% and 2.0% weight concentration of gelator. The preparation of the gel electrolyte and its characterization, including determination of the ion conductivity, thermal properties, molecular interactions and gel microstructure are presented in this work.

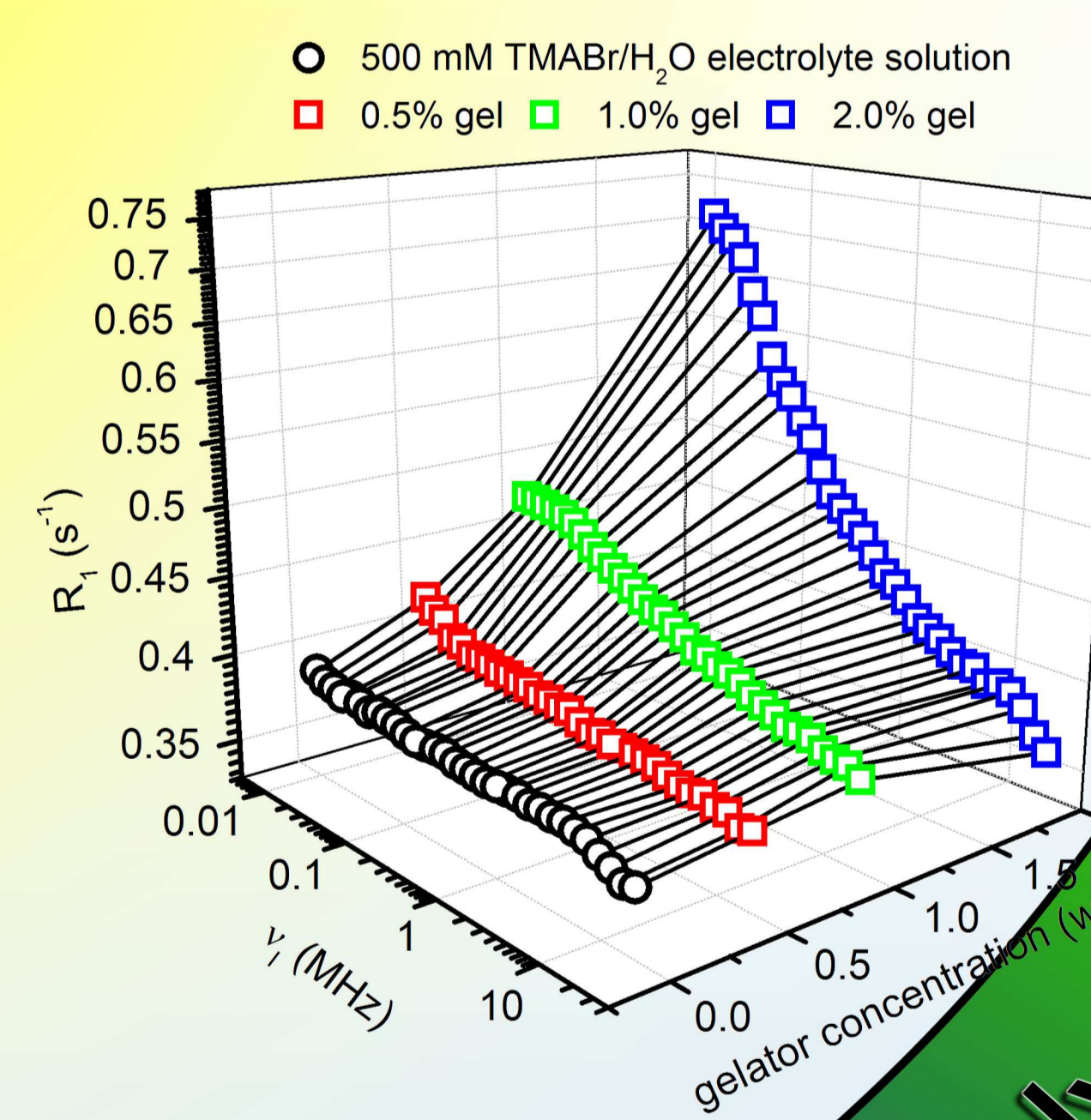
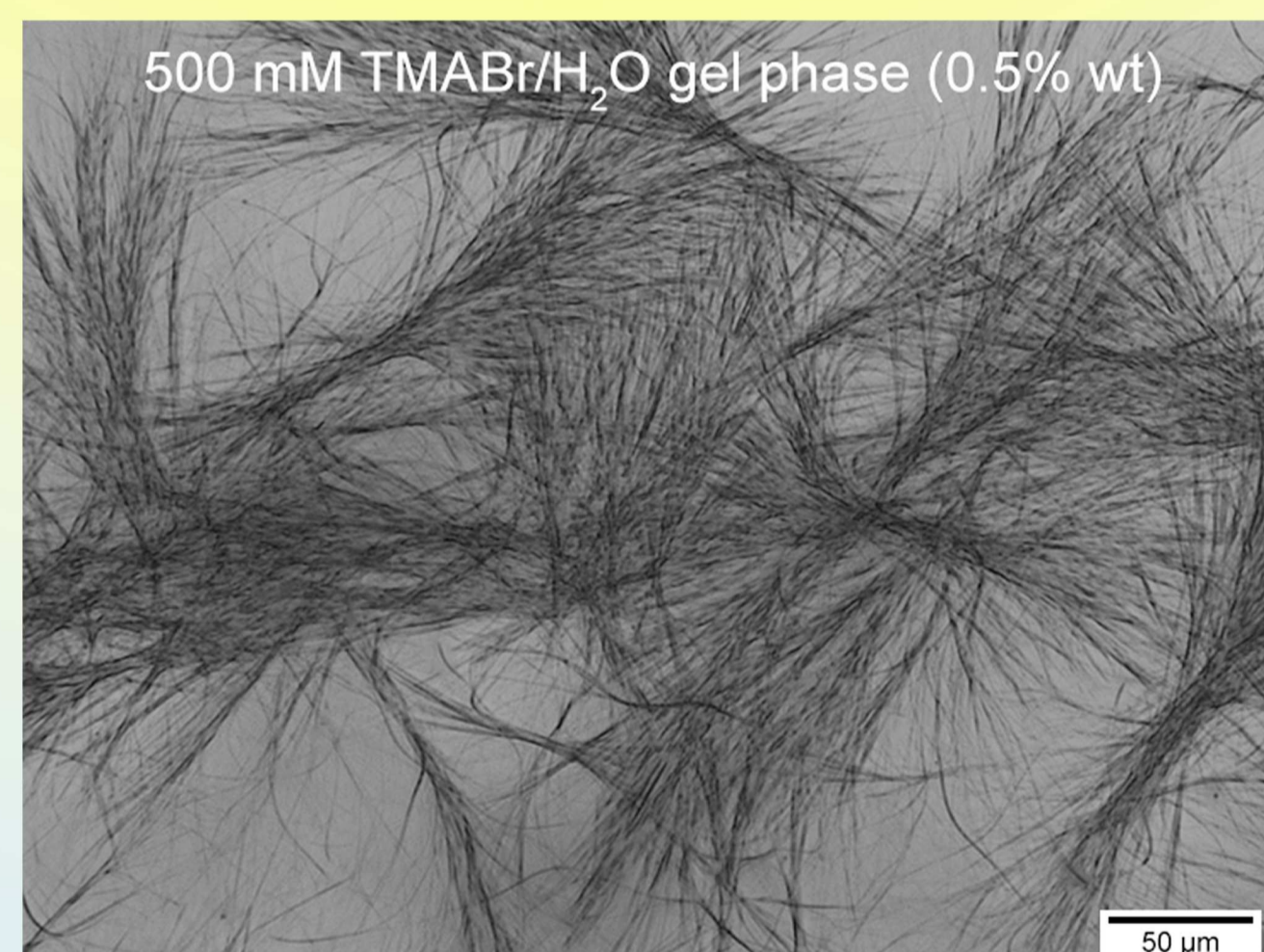
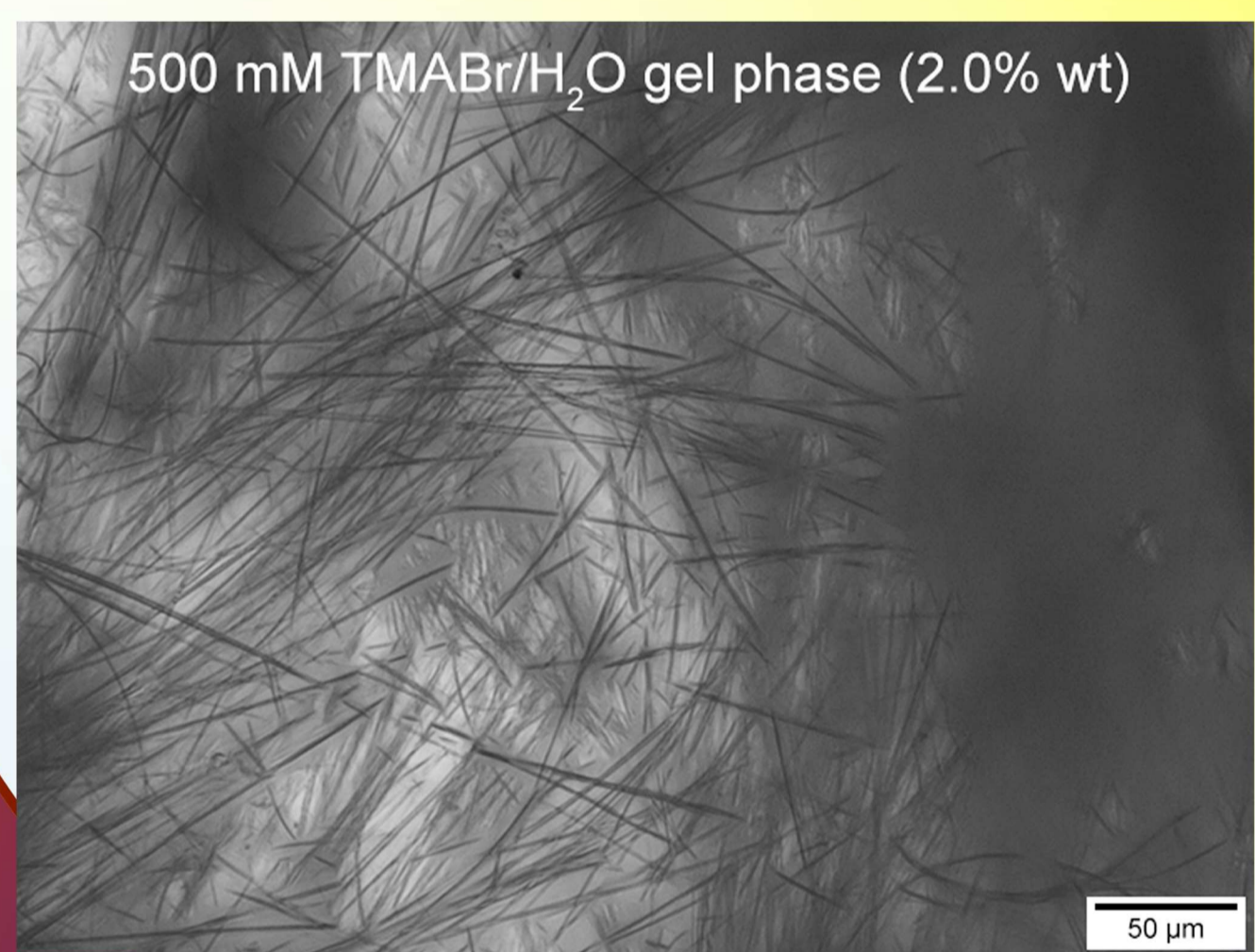
Thermal stability properties



Electric conductivity properties



Gel electrolyte microstructure



Molecular dynamics

Conclusions

The results presented in the paper have shown that the monosaccharide low molecular weight organic gelator, methyl-4,6-O-(p-nitrobenzylidene)- α -D-glucopyranoside (1) and the aqueous solution of tetramethylammonium bromide can be successfully used for preparation of gel electrolytes. Interesting result has been obtained for the conductivity of the electrolyte gels. Contrary to the majority of GPE systems, the low molecular weight gel electrolyte formed by self-assembly of gelator (1) in tetramethylammonium bromide (TMABr) aqueous solution exhibits a higher electric conductivity than that of pure electrolyte solution. The reason for the conductivity enhancement is related to the solvent electrolyte-gel matrix interactions. The occurrence of these interactions is well revealed by the low frequency dispersion of the proton spin-lattice relaxation time of the electrolyte solution in the gel phase measured by the FC NMR relaxometry method. The electrolyte gels obtained were stable in time, had long cycle life and were characterized by very good reproducibility. Therefore, they have the potential to be good alternative for common chemical electrolyte gel.

References

[1] Bielejewski M., Puzkarska A., Tritt-Goc J. *Electrochimica Acta* 165 (2015) 122-129

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