Spectroscopy studies of sodium ions with ionic liquids

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Ionic liquids (ILs) have a wide range of potential applications in chemistry and also in biotechnology. These compounds are composed of an organic cation group and organic or inorganic anion. Depending on the structure of the anion and cation groups ILs can show a wide range of properties. Ionic liquids exhibit very low vapor pressure, therefore the are widely used in industry and chemistry as a green solvent. Furthermore, they show also promising application potential in biochemistry, medicine and pharmacy, especially in the development of drug delivery systems. Ionic liquids can be for example used as solvents for DNA. It was shown that hydrophilic ionic liquids can stabilize the structure of DNA and G-quadruplexes, and play a role similar to molecular crowding agents. The aim of this research was to study the interactions between sodium ions and imidazolium ionic liquids by the use of different spectroscopic techniques.

In our studies we examined two different ionic liquids: 1-butyl-3-methylimidazolium acetate (BMIM Ac) and 1-butyl-3-methylimidazolium formate (BMIM HCOO) by the use of two complementary NMR spectroscopic techniques. First was ultrasensitive β-detected NMR on radioactive sodium-26 in low magnetic field. β-NMR is a powerful tool which is highly sensitive in comparison to the NMR spectroscopy. This technique allows to break limitation of classical NMR as a condition of spin values. In case of this method β particle is detected instead of absorption of RF radiation. Those measurement was performed at the VITO setup at ISOLE facility at CERN. ^{23}Na NMR and ^{1}H NMR spectra of ionic liquids were collected on NMR Agilent 400 MHz spectrometer in Nanobiomedical Center (Poznań).

^{26}Na NMR resonances recorded at CERN show relatively narrow peaks for BMIM Ac and BMIM HCOO and in Na-Ac dissolved in those ionic liquids. Chemical shifts and relaxation times were recorded. In case of stable sodium NMR for each solution of sodium acetate in ILs one narrow and one wide peak was detected. T_1 and T_2 relaxation time were also measured .

Our studies show that βNMR technique is suitable to examine interaction of sodium ions. Our next step is to examine model biological system - interactions between sodium ions and DNA G-quadruplexes.