Thermal Stability of Ionic Liquids: Evaporation Vs Decomposition, TGA and DSC

Dzmitry Zaitsau [C, S]
Department of Physical and Theoretical Chemistry Institute of Chemistry, Competence Center CALOR department Life, Light and Materials, University of Rostock, Rostock, Mecklenburg-Vorpommern, Germany
zaitsaudz@gmail.com

The industrial application of ILs should be supported with the knowledge of thermal stability and corresponding lifetime duration of the IL phase. So, as an answer to the increasing needs on stability of ILs during the last decade the amount of experimental studies on thermal decomposition of ILs by using simple temperature scan in commercial TGA increased significantly. Such simple studies reveal the "decomposition temperature" T_d, which is given as the onset temperature of the mass loss increase in experimental conditions.

Nevertheless, this simple and fast method doesn't provide the correct information and understanding of the decomposition kinetics. Firstly, the kinetic decomposition is not a phase transition and cannot be described by a single temperature without additional information on the rate of a chemical reaction. Secondly, the total mass loss in TGA device is a combination of the mass loss rates due to vaporization/sublimation process and chemical decomposition.

In the current study the results of analysis of decomposition kinetics for ILs with 1-alkyl-3-methylimidazolium cation. The results were determined with TGA and DSC techniques and analysed by using the approach of isoconventional kinetics. The experimental results show that the simple and straightforward application of TGA technique leads to the average value of activation energy of the decomposition process and sublimation/vaporization enthalpy of samples. Therefore, the results of simple TGA study give the inconsistent results. The experimental decomposition study was compared with the quantum chemical analysis of possible decomposition pathways.