Thermal stability of molecular and ionic compounds: evaporation vs decomposition, TGA vs DSC.

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Ionic liquids (ILs) are acknowledged as new perspective “green” solvents and reaction media. It is declared that ILs are characterized by extremely low vapor pressures and high thermal stability. The last statement is very questionable since the charge in the organic molecule increases the reactivity of the corresponding atom or group in chemical transformations.

During the last decade the amount of experimental studies on thermal decomposition by using simple temperature scan in commercial TGA increased significantly . As a result of such study, the “decomposition temperature” T_d is given as the onset temperature of the mass loss increase in experimental conditions.

This simple and fast method doesn’t provide the correct information and understanding for decomposition kinetics of studied materials. Firstly, it should be taken into account that 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 molecular compounds like cytosine, o-, m- and p- phthalic acids together with the results for the most common ionic liquids are presented. All the results are analyzed by using the isoconventional kinetics approach. The experimental results show that the simple and straightforward application of TGA technique leads to getting the average value of activation energy of the decomposition process and sublimation/vaporization enthalpy of samples. Therefore, it is reasonable to combine TGA study with DSC research in which measured heat flow is not affected significantly by the evaporation process.