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Thermal hazard analysis and flammable characteristic of two imidazolium nitrate ionic liquids

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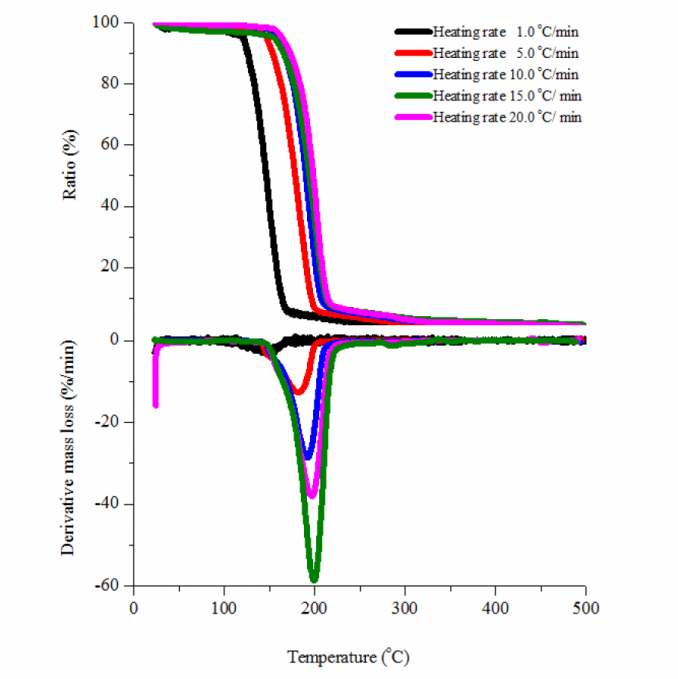
PURPOSE OF THE ABSTRACT

Ionic liquids (ILs), the molten salts with low melting points below 100 oC, are widely applied as a green solvent that combines organic cations with organic or inorganic anions. ILs have a specific task and sound applications because of their unique advantages, such as low vapor pressure, high thermal stability, non-toxic, and absence of flammability. Nevertheless, previous studies have confirmed that ILs under high temperature could decompose rapidly and the decomposed products, being thermally sensitive, could incur ignition and spontaneous combustion. To understand the thermal hazard properties and explosive properties of 1-methylimidazolium nitrate and 1-butylimidazolium nitrate, this study employed thermogravimetry (TG) and differential scanning calorimetry (DSC) to acquire the thermokinetic parameters for process safety assessment. Moreover, flash point analysis was applied to observe the combustion phenomenon and obtain the flash point value. On the other hand, the theoretical and structural analysis on the free radicals during the decomposed reaction of two ionic liquids was resolved by Gaussian software. The summary thermal hazard analysis and explosive test results would be established the intrinsically safe parameters of ILs.

FIGURES



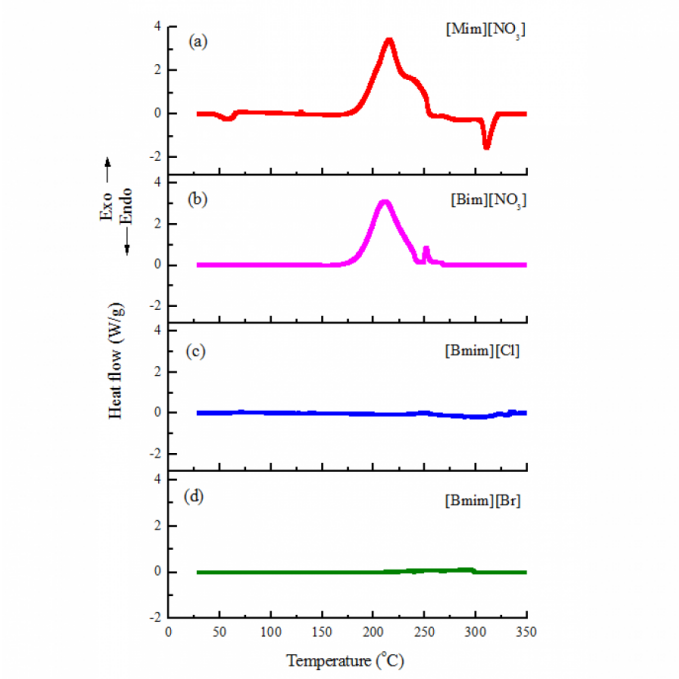


FIGURE 1

The weigh loss of [Bim][NO3] at 1.0, 5.0, 10.0, 15.0 and 20.0 oC/min

The mass loss curve illustrates that corresponding temperature of maximum mass loss derivative would be increased by higher heating rate due to thermal hysteresis, but the overall results showed that the maximum mass loss derivative would occur before 200

FIGURE 2

DSC thermal curve for [Bmim][Br], [Bmim][Cl], [Bim][NO3], and [Mim][NO3] at dynamic heating rate of 4.0 oC/min.

DSC results show differences of exothermicity between the anions. Nitrate anion, which easily produces an explosion reaction, begins to release obvious heat at about 160.0 to 250.0 oC; however, thermal analysis curves showed ILs combined with bromine and

KEYWORDS

Ionic liquids (ILs) | Thermal hazard | Explosive properties | Gaussian software

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