Autocatalytic Thermal Decomposition Properties and Adiabatic Safety of Nitroguanidine

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Abstract: Thermal decomposition characteristics of nitroguanidine(NQ) was preliminary studied by differential scanning calorimetry (DSC) dynamic experiment, and the Kissinger and Ozawa method were used to calculate the activation energy of thermal decomposition. The effect of thermal history on the thermal stabilities of NQ was investigated by "interruption and re-scanning" method, and the conclusion was verified with the isothermal DSC experiment. The adiabatic security of NQ was investigated by the adiabatic calorimeter (ARC), and the initial decomposition temperature and heating rate were obtained. Results show that NQ is an energetic material decomposing with melting, and the thermal decomposition is autocatalytic reaction. Thermal history significantly influences the thermal stability of NQ, decreasing the initial thermal decomposition temperature and the peak temperature and increasing thermal decomposition rate at solid state. The initial thermal decomposition temperatures are 213.8–249.9 ℃, whereas the peak temperatures are 215.0–255.2 ℃ at heating rates of 2, 5, 10 ℃ · min^{-1} and 20 ℃ · min^{-1} by dynamic DSC analysis. The apparent activation energy is 111.6 kJ · mol^{-1} and 114.2 kJ · mol^{-1}. The initial decomposition temperature is 170.6 ℃ and the maximum heating rate is 1.414 ℃ · min^{-1} for adiabatic experiment.

Key words: nitroguanidine; autocatalytic(NQ); "interruption and re-scanning" method; differential scanning calorimetry(DSC); adiabatic calorimeter(ARC); thermal decomposition

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