THERMAL STABILITY OF ENERGETIC MATERIALS: HIGH-PRESSURE DIFFERENTIAL SCANNING CALORIMETRY STUDY

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Abstract: Thermal behavior of high-energy materials (TNT, ammonium perchlorate (AP), and ammonium dinitramide (ADN)) is studied in the pressure range 0.1–10 MPa with high-pressure differential scanning calorimetry technique (HP DSC). Experiments revealed that the pressure increase considerably changes the AP decomposition pathway, i. e., two-stage thermolysis at 0.1 MPa is replaced by the single-stage one at 5 MPa with the considerable increase of heat release in condensed phase. For TNT, the pressure increase results in the sign alteration of the heat effect: endothermic evaporation is replaced by the exothermic decomposition peak. Detail investigation of thermal decomposition of ADN reveals similarity of two dependencies on pressure — of the burning rate and of the rate of heat release during thermal decomposition. Experimentally obtained pressure exponents for both dependencies are almost equal. The results revealed that HP DSC is a promising technique to improve our knowledge of the energetic materials decomposition and to predict the thermal behavior under the pressure, which is close to the conditions of potential use of these materials.

Keywords: energetic materials; high-pressure differential scanning calorimetry; ammonium dinitramide; decomposition

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