Abstract

The thermal decomposition of ammonia borane was studied using a variety of methods to qualitatively identify gas and remnant solid phase species after thermal treatments up to 1500 °C. At about 110 °C, ammonia borane begins to decompose yielding H2 as the major gas phase product. A two step decomposition process leading to a polymeric -[NH═BH]n- species above 130 °C is generally accepted. In this comprehensive study of decomposition pathways, we confirm the first two decomposition steps and identify a third process initiating at 1170 °C which leads to a semicrystalline hexagonal phase boron nitride. Thermogravimetric analysis (TGA) was used to identify the onset of the third step. Temperature programmed desorption-mass spectroscopy (TPD-MS) and vacuum line methods identify molecular aminoborane (H2N═BH2) as a species that can be released in appreciable quantities with the other major impurity, borazine. Attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR) was used to identify the chemical states present in the solid phase material after each stage of decomposition. The boron nitride product was examined for composition, structure, and morphology using scanning Auger microscopy (SAM), powder X-ray diffraction (XRD), and field emission scanning electron microscopy (FESEM). Thermogravimetric Analysis−Mass Spectroscopy (TGA-MS) and Differential Scanning Calorimetry (DSC) were used to identify the onset temperature of the first two mass loss events.