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CHARACTERISATION AND ELECTROLYTIC DECOMPOSITION OF ADN-HAN MIXTURE IN A POLYMER MICROPROPULSION SYSTEM

Abstract

Although Ammonium Dinitramide (ADN) has been poised to replace conventional solid rocket fuel for ages because of its various unique advantages, its application is still very limited due to complicated synthesis methods. Most of the synthesis method based on nitration methods with low yield [1,2]. According to our investigation, the most critical stage in the synthesis of ADN is the adding of nitration mixture into the cold water mixture. Fast addition of the solution leads to liberation of hot dark brown fumes with temperature in the solution shot up to 15 0C from -45 0C.

Although ADN always used as a solid fuel, it still display considerable thermal characteristics in liquid phase, with the performance comparable to that of Hydroxylammonium Nitrate (HAN). In a ADN-HAN mixture of at various proportions, DSC analysis revealed that the samples underwent similar trends of decomposition in which the first peak of energy released takes place at temperature approximate to 105 0C, in which the mass loss is equivalent to the proportion of HAN. Experimental data shows that 85:15 wt% of ADDN-HAN mixture is the best to provide highest energy output.

The mixture was then electrolytically decomposed in a micropropulsion system developed and fabricated with Poly-Dimethylsiloxane (PDMS) using modified soft-lithography method. The micropropulsion system has a serpentine channel connecting the reservoir to a microcombustion chamber. Commercial copper wires were directly poked through the polymer to act as electrodes to initiate electrolysis.

Our preliminary experimental observation shows flowrate of ADN-HAN mixture input flowrate should be optimised to 50μl/hr which can deliver performance yet compromising complex two-phase flow in the microcombustion chamber. More experimental work is currently being carried out to characterise the utility of ADN-HAN mixture in customised micropropulsion system. In addition, preliminary study also show that the decomposition phenomenon of the ADN-HAN mixture in the micro-combustion chamber is almost identical to that of 80 wt% HAN solution.

The novelty of this work lies in the development of ADN-HAN liquid fuel mixture and its electrolytic decomposition method in a micropropulsion system.

References:

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