

SPACE PROPULSION SYMPOSIUM (C4)  
New Missions Enabled by New Propulsion Technology and Systems (6)

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FEASIBILITY ASSESSMENT OF HAN-BASED THRUSTER USED IN THE MONOPROPELLANT  
PROPULSION SYSTEM

**Abstract**

Most monopropellant propulsion system use highly toxic hydrazine as the propellant in conventional spacecraft. The development of “green” propulsion was initiated as an alternative to hydrazine. One of the “green” propellants is the Hydroxyl ammonium Nitrate (HAN) based monopropellant which is a blend of HAN, water, fuel and other additives. HAN-based propulsion clearly provides numerous benefits over monopropellant hydrazine, including: lower toxic, higher volumetric efficiency, significantly reduced transportation/handling hazards and costs, greatly simplified/shortened pre-launch operations. However, the catalytic activity is low, and the combustion temperature is high, and the intermediate product is strong oxidization for the HAN-based monopropellant. So, the key technology of the HAN-based propulsion system is improving the catalytic activity of propellant and prolonging the life of the catalyst. For the HAN-based monopropellant, the derivative of hydrazine is added to increase the catalytic activity, and the oxygen balance is adjusted to avoid the catalyst oxidized. For the catalyst, dual active metals with appropriate ratio are employed to improve the reaction rate of the catalytic decomposition reaction and catalytic combustion reaction. The method of dual active metals also can eliminate the pressure peak of preheating start and prevent the oxidization of catalyst by the intermediate product. Besides, the support of the catalyst is ceramics material which is shaped under 1,400 to improve the capacity of high temperature resistance. Through above mentioned efforts, the technology of HAN-based thruster has yielded great progress. For example, the 5N HAN-based thruster can be started without pressure peak when the catalyst bed temperature is preheated to about 120, and can achieve more than 8,000s accumulated firing time and 1,200s longest continuous operation time. As a result, HAN-based monopropellant is a promising substitution of hydrazine and it is feasible to use HAN-based monopropellant on the propulsion system of all kinds of spacecrafts.