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NUCLEAR THERMAL ROCKET WUO2 FUEL FAILURE ANALYSIS AT NASA MARSHALL

Abstract

The NASA Marshall Space Flight Center (MSFC) is undergoing Nuclear Thermal Rocket (NTR) fuel development as part of the Advanced Exploration Systems (AES) program. Tungsten Uranium Oxide (WUO2) fuel was used during the United States' nuclear aviation program and is a potential candidate for NASA's modern NTR program. The decision to use a Cermet (ceramic metal) based nuclear fuel instead of a graphite based nuclear fuel, as was used during the United States' nuclear rocket programs nearly 50 years ago, is due to the cermet's ability to retain higher degrees of heat, therefore providing a higher velocity of the outgoing propellant passing through the engine's core and a higher thrust for the vehicle. The capabilities of the WUO2 fuel can be tested for operational integrity and accidental failure within experimental chambers that expose the fuels to stressful environments. This paper discusses the mechanisms of WUO2 fuel failure, a review of past tests and results, the MSFC CFEET device and the George Washington University arc jet. CFEET stands for Cermet Fuel Element Environmental Test, and works by heating a fuel sample with an RF coil, while subjecting the sample to flowing Hydrogen gas to simulate NTR propellant. The arc jet subjects the fuel sample to plasma ablation, which is useful for various scenarios, such as accidental re-entry and separation from the engine, which should show the core coming back as a block through the atmosphere, due to the thermodynamic properties of the Tungsten. Currently, surrogate samples are being tested while a test matrix for samples containing Uranium has been prepared for future use.