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OPTIMIZING THE UTILIZATION OF TITANIUM IN SPACECRAFT SUBSYSTEM TO ENSURE ITS FRAGMENTATION ON REENTRY

Abstract

the inclusion of Titanium and other hight thermally resisting materials in the construction of spacecraft subsystems offers a great optimization as due to its high strength, low weight, and excellent corrosion resistance. However, when spacecraft reach the end of their operational life and re-enter the Earth's atmosphere, the titanium components pose a significant risk. Unlike other materials that burn up completely upon re-entry, titanium does not combust and can survive intact, potentially causing harm to people and the environment on the ground. Therefore, it is crucial to develop methods to ensure the safe degradation of titanium components during re-entry to mitigate the risks posed by space debris.

In this paper the development of methodologies and trade-offs done by our team are present to decrease the impact of titanium on debris assessment during spacecraft re-entry. The addition of ablative thermal protection systems being effective in ensuring the safe degradation of titanium, it can add weight and complexity to the spacecraft, increasing launch costs and potentially reducing payload capacity. Self-destructing mechanisms, on the other hand, can be simple and lightweight but may pose a risk if they malfunction during operation.

Additionally, the use of biodegradable titanium alloys is briefly discussed as it can reduce the environmental impact of space debris but may require further research and development to ensure their performance and safety. Simulation and testing are also essential in refining and validating these methodologies, but they can be time-consuming and costly. Overall, the trade-offs made in selecting the most appropriate methodology for safe titanium degradation to balance performance, safety, and cost-effectiveness are discussed and present.