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Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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DROPPING KNOWLEDGE ON SPACE TRIBOLOGY: INSIGHTS INTO THE EFFECTS OF MICROGRAVITY ON SOLID LUBRICANTS FROM THE BREMEN TOWER DROP EXPERIMENT

Abstract

The performance of space mechanisms, such as satellite solar panels, hinges, and robotic arms, heavily relies on the tribological properties of the lubricants used in their design. Their mechanical properties can be significantly affected by the extreme conditions of outer space: including high vacuum, absence of oxygen, and extreme temperatures among others. However, due to technical challenges, the effects of microgravity on these properties are not entirely understood.

The SLuGG PETRI Project (Solid Lubricants in Gravity from Gdańsk) is a student research project from Gdańsk University of Technology, focused on studying the effect of microgravity and air pressure on the coefficient of friction in tribological systems.

The project utilized a novel vibrational tribometer that can measure friction with a few orders of magnitude smaller measurement uncertainty compared to classical tribometers. This allowed the team to identify the coefficient of friction in microgravity and analyze the ability of solid lubricants to dampen mechanical vibrations.

Experiment utilized a custom-designed cylindrical vacuum chamber that can simulate microgravity conditions through multiple drops in the Bremen drop tower. They also used a novel vibrational tribometer that can measure friction with a few orders of magnitude smaller measurement uncertainty than classical tribometers. Solid lubricants were applied to the bar, and data was collected from the vibration sensor

before and after lubricant application. The PETRI program, in collaboration with ESA, provided support for the project, which introduced valuable insights into the effects of microgravity on tribological systems.

The paper will discuss valuable insights into the effects of microgravity on the damping properties of solid lubricants in tribological systems, which can be useful for designers of space mechanisms, such as hinges, manipulators, drives, and grippers. The findings may also have broader implications for the development of more effective lubricants and tribological systems for use in space exploration.