COUNTERINTUITIVE EFFECT OF VACUUM LEVEL ON THE DURATION OF MOS2 SUPERLUBRICATION REGIME

M. DHIEB[a], J. SICRE[b], C. LEBRETON[c], C. TRIBILLON[c], JB. SANCHEZ[a] , G. COLAS[a]

[a] Université Marie et Louis Pasteur, CNRS, institut FEMTO ST, F 25000 Besançon, France, [b] CNES, 31401 Toulouse, France, [c] ADR Alcen, 77810 Thomery, France

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ABSTRACT

Improving the reliability of space mechanisms remains a major challenge for current and future missions. The reliability of tribological systems has become essential to mission success, as maintenance operations are rarely possible after launch. In this context, solid lubricants, particularly molybdenum disulfide (MoS_2), are widely used to ensure reliable tribological performance in harsh space environments [1].

However, MoS_2 must maintain its lubricating function throughout the entire life cycle of a space mission. From the assembly and ground testing phases to launch and operating conditions in orbit, or on planetary surfaces. The coatings are hence exposed to highly variable environments. MoS_2 films can thus be exposed to varying thermal and mechanical environments., typically ranging from 10^{-5} mbar to 10^{-9} mbar [2,3].

This study focuses specifically on the influence of vacuum level variations on the tribological behavior of MoS2 in burnished and PVD-deposited forms. Contact conditions are summarized table 1. We demonstrate in a reproducible manner that, although the friction level remains in superlubrication regime **($\mu \approx 0.007$)**, the wear life under a vacuum of 10-5 mbar is longer than at a vacuum level of 10-7 mbar (fig. 1). By analyzing the composition of the residual vacuum in the chamber and combining SEM, XPS, and Raman analysis, we attempt to explain this counterintuitive behavior. The presence of carbonaceous elements is particularly evident evident in some 3rd body aggloemrates after tests in 10-5 mbar. Crystalline MoS2 is nonetheless stil detected. Synergestic effetcs of water and residual elements with MoS2 are investigated. This study demonstrates the importance of a good understanding of test and operating environments in order to best predict the tribological performance of MoS2 deposits in space application.

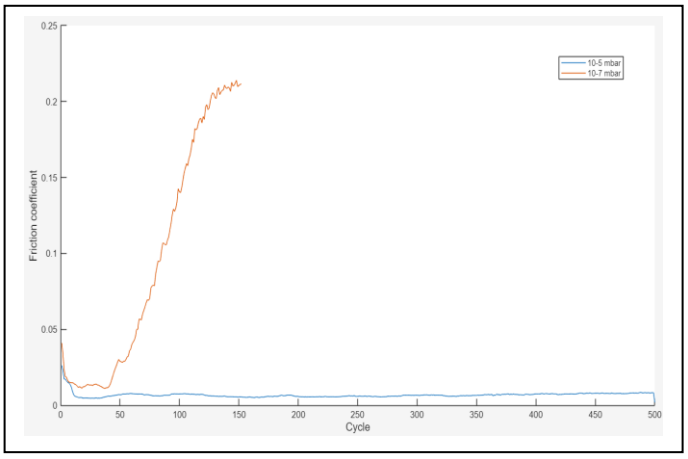


Fig.1 influence of Vacuum Level on Burnished MoS2 Friction Behavior

Table 1: Tribological test conditions

Parameter	Value
Coating	MoS_2 burnished
Contact configuration	Oscillating contact
Contact pressure	1 GPa
Rotation speed	8 mm/s
Number of cycles	500 cycles

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