

## MOS<sub>2</sub> LUBRICATING FILM MEETS SUPRAMOLECULAR GEL: A NOVEL COMPOSITE LUBRICATING SYSTEM FOR SPACE APPLICATIONS

Jiaying Zhang<sup>a</sup>, Meirong Cai<sup>a\*</sup>, Lijun Weng<sup>a</sup>, Feng Zhou<sup>a</sup>, Weimin Liu<sup>a</sup>

caimr@licp.cas.cn

<sup>a</sup> State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000, China

### KEYWORDS

*Composite lubricating system; Friction mechanism; Supramolecular gel; Transfer film; Space applications.*

### ABSTRACT

In the field of space mechanical lubrication, in order to improve the reliability and life of space lubrication, solid lubricating film-liquid lubricant composite lubrication has been used in recent years. This lubrication method can improve the durability of sliding friction mating surfaces, reduce equipment wear, and extend the service life of motion mechanisms. However, due to the unstable factors such as volatilization and creeping of liquid lubricants in microgravity and ultra-high vacuum environments, the solid lubricating film will wear out after long-term use, and produce wear debris and other unfavorable factors. In order to solve the above problems, this study proposes a novel composite lubrication system constituting of MoS<sub>2</sub> film in combination with a supramolecular gel. The tribological performance of this lubrication system establishes an extended service life with a lower wear rate than MoS<sub>2</sub> film, regardless of functioning in vacuum or atmospheric conditions. More importantly, the results of the irradiation experiment demonstrate that the MoS<sub>2</sub>-gel exhibits better anti-creep performance as compared to MoS<sub>2</sub>-oil when exposed to atomic oxygen and ultraviolet light for 4 hours. The analysis of this composite lubrication mechanism also reveals the formation of a continuous transfer film on the surface of the friction pairs by virtue of the outstanding synergistic effect between MoS<sub>2</sub> film and gel. MoS<sub>2</sub> debris is present in gel as an additive, and gel is capable of replenishing automatically once the MoS<sub>2</sub> film depletes. Moreover, the strong anti-creep properties of gel are

attributable to the multialkylated cyclopentane oil being trapped by intricate reassembling of the gelators network. It is firmly believed that this novel MoS<sub>2</sub>-gel composite lubrication system may have good prospective applications in space and special machinery domains.

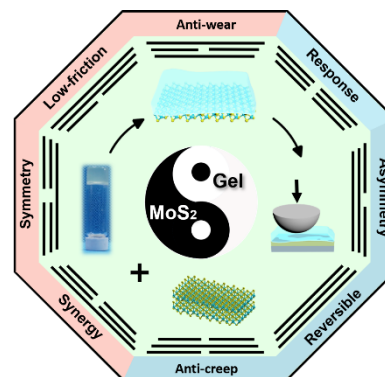


Fig.1 Schematic diagram of MoS<sub>2</sub>-gel lubrication system

### ACKNOWLEDGMENTS

We are very grateful for the funding support of the National Natural Science Foundation of China (U23A20623).

### REFERENCES

- [1] Afanasiev, P., Lorentz, C. The Journal of Physical Chemistry C 2019, 123 (12), 7486-7494.
- [2] Zhang, J. Y., Jiang, D., Wang, D. S., Yu, Q. L., Bai, Y. Y., Cai, M. R., Weng, L. J., Zhou, F., Liu, W. M. ACS Applied Materials & Interfaces 2021, 13, 48, 58036–58047.