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Title

Surfaces for space exploration

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Abstract

The return to the Moon and ensuring sustainable exploration with the aim of extending them to Martian exploration require new targeted research & development efforts. With the first step of the successful launch of Artemis I mission, flyby of the Moon and safe return of the Crew Module complete, research laboratories are motivated to identify mission threats and to benefit from the significant progress in materials science which could be applied to these questions. This paper reviews challenges linked to different surfaces; those exposed to a harsh external environment and those making up the interior of space stations, illustrating them with selected ESA-funded projects.

The issue of biofilm formation in the confined environment of the ISS and the interior of spacesuits in general will be amplified by limited access to resources, decreased immune response of the crew and increased virulence of mutating microbes [1]. There are efforts towards achieving robust low-cytotoxicity surface treatments, especially for wet applications (e.g. water pipes), without heavy metals as it has been shown that these metals tend to leak into water condensate. This project resulted in efficient coatings based on natural antimicrobial agents and active nanoparticles, presented here. Moreover, in another project, photoactive surface treatments with titanium compounds also resulted in effective antimicrobial barriers with long-term stability which could be additionally helpful in bioburden control.

For surfaces directly exposed to the lunar environment, a significant challenge will be their interaction with abrasive and electrostatically charged lunar dust. This challenge was underlined by lessons learnt from the Apollo missions. This is applicable to EVA suit external layers as well as thermal control surfaces, mechanisms and seals. Technology development efforts aiming at characterization of the impact of lunar dust on various materials, as well as mitigation strategies for the dust, will be summarized. In the framework of the PexTex (Planetary Exploration Textile) project selection of state-of-the-art textiles for external surfaces of EVA suit for lunar exploration was undertaken [2]. An extensive series of material tests, including nuclear accelerator-based radiation tests, abrasion tests on a Double Head Abraser and in a tumbler chamber were performed using lunar regolith simulants. Moreover, impact of the lunar dust simulant on OSR surfaces' thermooptical properties was studied to reveal linear alpha/epsilon dependences.

References

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