

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)  
Smart Materials and Adaptive Structures & Specialized Technologies, Including Nanotechnology (9)

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SUSTAINABILITY ASSESSMENT OF PLASMA-ASSISTED PROCESSES FOR THIN FILM  
DEPOSITION IN SPACE APPLICATIONS

**Abstract**

In the next years, humankind will return to the Moon. The future of space exploration will allow for the settlement of space bases to study our natural satellite in more detail and prepare for trips to Mars. The coordination of international efforts from different space agencies is required to prepare for this new phase of space exploration. As part of the ESA's (Terra Novae) exploration program and in the context of the ESA's program for exploration, research, and technology (ExPeRT), initiatives named Spaceship have been created in several countries (Germany, England, and France). These innovation environments facilitate the study of new operational concepts and new technologies, with the support of expert engineers, astronauts, and a large-scale network of researchers. As part of this approach, Spaceship FR from the French agency – CNES plays a pivotal role in preparing for the future of space exploration and fostering technologies that can find also many application and inputs on Earth. Within the context of Spaceship FR objectives, this study analyses plasma-assisted technologies for thin film deposition, addressing numerous challenges inherent in lunar exploration and settlement. Emphasizing the efficiency of aerosol-assisted plasmas, particularly in the application of multifunctional coatings, this paper provides a comprehensive review. Special attention is given to the material balance of the global process, emphasizing strategies to optimize sustainability during the deposition phase. Additionally, the economic benefit – cost analysis associated with improved material balance are discussed.