SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Technologies (5)

Author: Dr. Lucia Pigliaru
Aviospace S.R.L, Italy

Dr. Ciro Borriello
Aviospace S.R.L, Italy
Dr. Fabrizio Piergentili
University of Rome "La Sapienza", Italy
Prof. Fabio Santoni
University of Rome "La Sapienza", Italy
Mr. Stelvio Pituccio
Italy
Mr. Emanuele Pensavalle
Aviospace S.R.L, Italy

EXPANDED POLYURETHANE FOAM FOR ACTIVE DEBRIS REMOVAL

Abstract

Space debris represent a real threat for operative missions, particularly in LEO, where a large amount of space activities is carried on, including human missions. To preserve the near Earth environment, the only possible solution, besides mitigation strategies, is active debris removal (ADR). The identification of an efficient capture system to allow a safe catching of the debris is key issues of ADR. The use of expanded polyurethane foams can allow simultaneous debris capture and attachment to the processing device. Even if the expanding foam concept has already been proposed as drag augmentation device for deorbiting of non-cooperative objects (e.g. ESA Ariadna), it can be innovatively employed to create a rigid link between chaser and target debris. In fact, the high contact surface provided by the foam, which can adapt to various volumes and shapes, is an asset vis-à-vis various target configurations, wall surface states, and debris tumbling. This paper is aimed to explore and introduce research in this topic, w.r.t. a joint project between Airbus Defence Space, University of Rome, University of Bologna and Duna-Corradini S.p.A. in the frame of RD. The technical objective of this project is to develop and qualify for space in a ground test environment gluing systems based on polyurethane expanded foams. The foam is generated from two liquid reagents. After being properly mixed, they produce a foam that, after expansion, becomes rigid. This foam has the capability to glue to parts with different material and shape and to produce a rigid link with the spraying vehicle. As the foam is sprayable, it simplifies greatly the actions required to grab an uncooperative orbiting objects since docking is not required and virtually any debris can be caught despite of its material, shape and even rotational state. Moreover, this concept is foreseen to be used either for passive deorbiting (up to 25 years) or for active deorbiting (with higher forces and torques to sustain). Finally, the foam capture concept under study would reduce risks related to hard contacts between target and chaser and would enable a better distribution of contact force. A future development expected to further increase foam performance is the addiction of nanoparticles to the compound, thereby achieving an increased functionalization of the material.