IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

Author: Mr. Vincenzo Mazzella
Alpha Impulsion, France, vincenzo.mazzella@alpha-impulsion.com

# ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF A H2O2-HDPE HYBRID AUTOPHAGE ROCKET ENGINE

**Abstract**

This paper presents the outcomes of the static fire test campaign conducted on the Ambre engine at DLR M11 Facilities. Ambre is the first small-scale prototype of a hybrid autophage launcher. This architecture involves the use of the launcher's fuel as a structure, removing the need for tanks and halving the rocket's dry mass. During flight, the length and the mass of the rocket continuously decrease, resulting in a single-stage-to-orbit launcher with a better overall performance and reduced cost thanks to its simpler design and logistics.

The work presented in this paper serves as a follow-up of the firing tests conducted in January 2023 by Alpha Impulsion. The ballistic analysis of the conventional single port geometry of HDPE, under 90Engine ignition is achieved and sustained thanks to the catalytic decomposition of hydrogen peroxide in a low L/D catalyst bed filled with Al2O3 pellets coated with manganese oxides. The autophage configuration implies that the latter bed is inside the combustion chamber and gets cooled by the refreshing fluids flowing internally and externally to its structure. Insertion of propellants is achieved thanks to an electric embedded systems developed and patented by Alpha Impulsion. Different velocities of insertion (called autophage velocities) have been tested and results on the different performance, together with the possibility of throttling the engine are presented. The insertion system developed is, at the state of the art, the only system allowing a ready-to-fly use of the hybrid autophage technology. In conclusion, this abstract highlight the significant advancements made in the development of the Ambre rocket towards its first experimental launch . This will finally prove the concept of hybrid autophage propulsion in a sounding rocket, paving the way for a larger scale prototype.