

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)  
Space Environmental Effects and Spacecraft Protection (6)

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## EARLY RESULTS FROM THE DISCOVERER PROJECT

**Abstract**

DISCOVERER is a Horizon 2020 project developing technologies to enable the commercially viable, sustained-operation of satellites in very low Earth orbits (VLEO) for communications and remote sensing applications. These technologies include:

- materials that encourage specular reflections of the residual atmosphere in free molecular flows, which can be used in concert with the design of external satellite geometries to minimise drag, and generate lift for aerodynamic attitude and orbit control.
- aerodynamic attitude and orbit control methods, which are essential at lower altitudes to complement traditional attitude control actuators.
- atmosphere breathing electric propulsion (ABEP), combining an optimised atmospheric intake with advanced Helicon thruster (IPT), to effectively remove the lifetime limits resulting from finite propellant for drag compensation.
- environment monitoring payloads with the potential to provide active feedback for aerodynamic attitude and orbit control.

Progress in 2020 was affected by the COVID-19 pandemic but did see the first ignition of our ABEP prototype IPT, and early 2021 saw the return of materials samples from the MISSE exposure facility on the International Space Station in a test designed to demonstrate the survivability of candidate novel materials. 2021 will see a number of milestones for the project including:

- the commissioning of our Rarefied Orbital Aerodynamics Research facility (ROAR) which can characterise the reemission characteristics of a beam of atomic oxygen (the predominant gas species in VLEO) at orbital velocities with material samples, and thereby determine their reflection properties, and which allows the testing of sub-scale atmospheric intakes.
- the launch of our Satellite for Orbital Aerodynamics Research (SOAR) which will validate the aerodynamic performance of materials and demonstrate aerodynamic manoeuvres.

The paper will provide highlights from the developments, and demonstrate the potential for a new class of aerodynamic commercial satellites operating at altitudes below the International Space Station.

The DISCOVERER project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 737183. This publication reflects only the view of the authors. The European Commission is not responsible for any use that may be made of the information it contains.