Plume Additive for Reducing Surface Ejecta and Cratering

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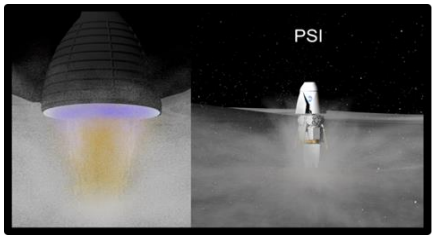
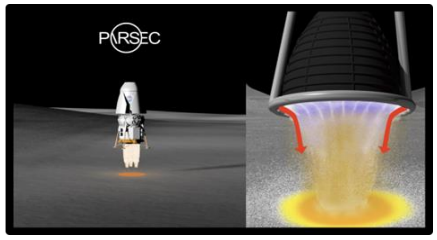
Project Objective

Keep astronauts and lunar assets safe from the effects of plume-surface interactions (PSI) by developing a system that conglomerates regolith particles beneath the lander to form a temporary landing pad.



Without Additive



With Additive

Additives

Powdered ceramics and metals that will be injected into the lander plume, accelerated, melted, and re-solidified upon contact with the lunar surface.

Alumina:
Cheap and lightweight ceramic capable of melting in plume

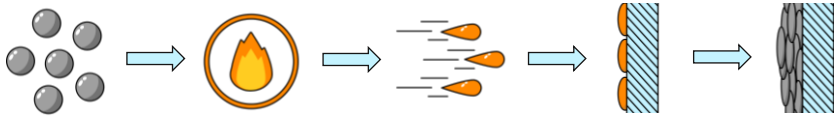
ZTA:
Alumina alloyed with zirconia to increase flexural strength and fracture toughness

Yttria-Stabilized Zirconia:
Dense ceramic with high thermal shock resistance and tensile strength

Nickel Alloy:
Dense metal with high thermal conductivity and low melting point for fast melting in plume

Thermal Spraying Process

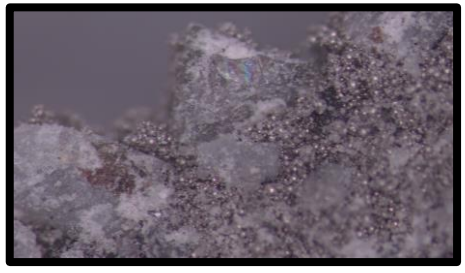
PARSEC uses a scaled-up version of thermal spraying, a common industrial coating process, to form temporary landing pads on the Moon.



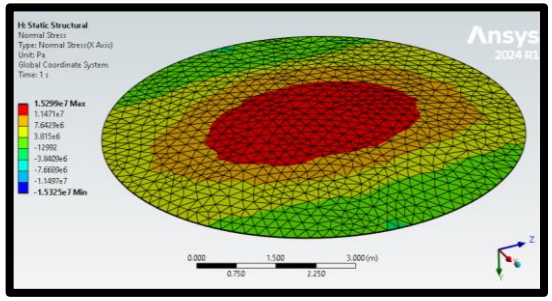
Torch Experiment

After completing a series of 18 tests in April of 2024, PARSEC achieved a 100% success rate of conglomeration with a Nickel Alloy additive, forming a total of 5 pad-like formations out of LSP-2, a lunar regolith simulant, and 2 formations on sand.

PARSEC's 60 second test formed a high-strength pad with a 6 cm diameter and a depth of 0.5 cm, which showed characteristics in line with PSI mitigation. The success of our small-scale testing operates as a functional proof of concept and should continue with further at-scale testing.

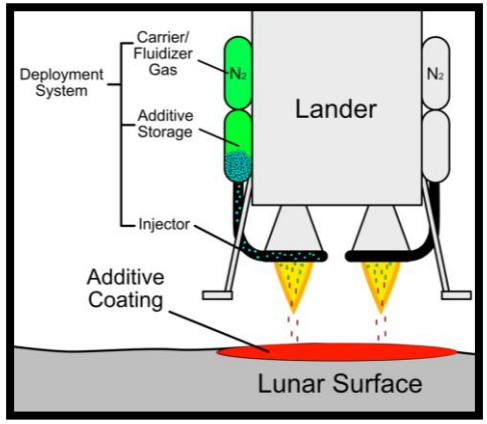


Simulation Analysis



Simulations conducted suggest that PARSEC's solution could potentially withstand the load of a lunar lander's plume.

System Design



Analysis has reaffirmed that this solution can be attainable on a realistic 3 to 5-year timetable with minimal cost, and overall supports its use in the Artemis Program.

HuLC Forum → Additional Testing → Reiterate Designs → Manufacturing → Fully-Integrated Testing

Estimated Project Cost: **$55M**