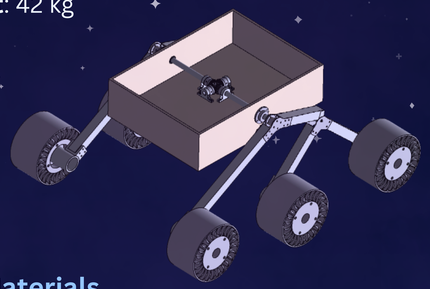
MICROWAVE-SINTERING OPERATIONS OF NANOPHASE-IRON PADS (MOON PADS)

Rover Design

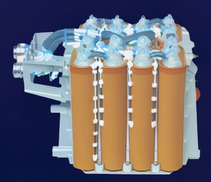
Size and Weight

Stored Dimensions: 200 cm x 40 cm x 60 cm
Deployed Dimensions: 200 cm x 40 cm x 135 cm
Total Weight: 42 kg



Primary Materials

Microwave: Titanium Grade 5
Body and legs: Aluminum 6061 T-6
Wheels: Zinc coated steel mesh with a spun woven aluminum center with titanium chevrons



Power Generation & Storage

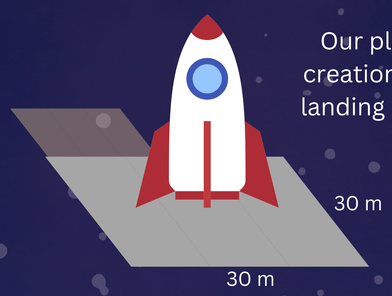
Solar Panels: Generates 862 W at a size of 1 m x 2 m with motor for panel movability
Lithium Ion Batteries: Stores up to 1200 Wh for buffer

Rover Versatility

Once completing the initial landing pad, they can be transferred to other locations to complete similar processes. Additionally, this sintering technology can also be applied to infrastructure construction, such as permanent structures and roads.

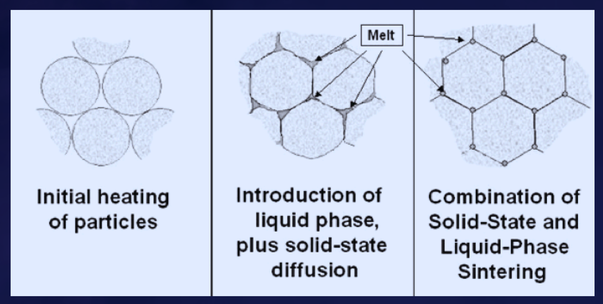
Capability

Our plan consists of the creation of a 30 m x 30 m landing pad in ~300 days.



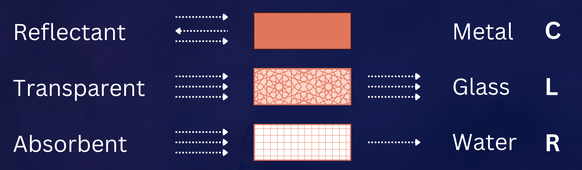
Microwave Sintering

Microwave Sintering is the process of fusing a solid material, usually in a powdered form together. This is typically done by melting a small amount of the powder to fill voids in between the powdered material.



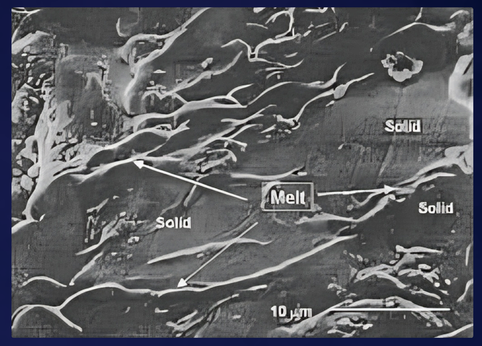
Sintering progress of powder particles by microwave energy [1]

In our case, absorbent regions of the lunar reoglith absorb microwaves, melting and fusing the dust together.



Interaction of Materials with Microwaves [1]

The advantage of this method is that energy is focused on conductive regions which reduces overall energy consumption. It also means that the material can form large temperature gradients which can lead to variance in the material properties.



Microwave melting along grain boundaries of mare soil [1]

Nanophase Iron

Unlike lunar simulants, lunar regolith contains significant concentrations of nanophase-iron which act as conductors for microwave energy.

26 Fe

Compared to Apollo 17 samples to JSC-1 Lunar Simulant, the Apollo 17 samples sintered 2.5x faster with half the power, for an overall 5x increase in sintering efficiency.

Sintering Benefits

By utilizing a landing pad made of sintered materials from the lunar surface, damage to landing craft and any other material around the area can be reduced significantly. No additional materials need to be brought to the lunar surface, as microwave sintering only requires materials found on the moon.

Concept of Operations

- Sintering rover is delivered from LEO into lunar polar orbit via a Translunar Injection
- After arriving in polar orbit, a skycrane will deliver the rover to the moon, allowing for minimal PSI inpingement
- Once on the ground, the sintering rover begins sintering the lines which will make up the landing pad
- General Sintering Pattern: the rover sinters 30 m long strips, which make up the landing pad
- Once completed, the sintering rover can be repurposed or deployed to another site

Impacts

Scientific: Life-support systems development including solid-support substrates for plant growth, sources for extraction of plant-growth nutrients, substrates for microbial populations of degradation of wastes, and sources of O2 and H2.

Financial: Decreased spacecraft maintenance and increased reusability. Reliance on required materials from Earth for infrastructure decreases.

Social: It is capable of supporting a growing amount of landings and launches to and from the Moon, demonstrating sustainability of the landing pad.

[1] Taylor, L. A., & Meek, T. T. (2004).

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HUMAN LANDER CHALLENGE

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