LUNAR RESOURCES

Fabricating Reflective Coatings in the Vacuum of Space

Elliot Carol, CEO

Lunar Resources, Inc.
Houston, TX

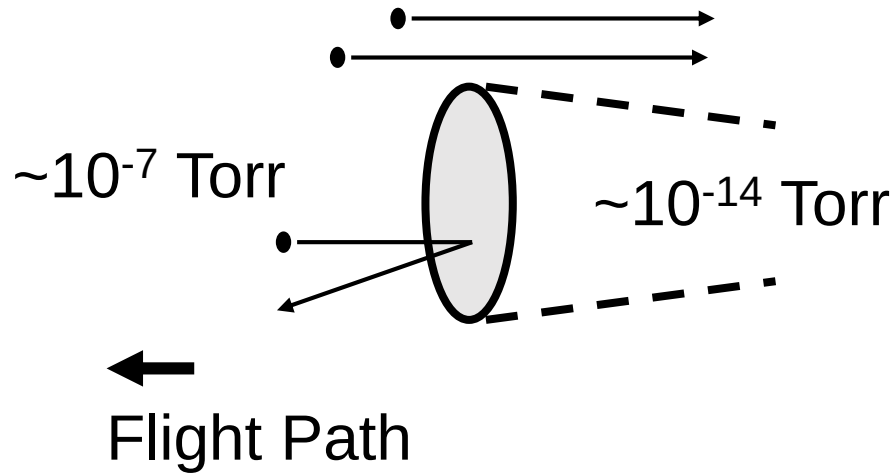
LUNAR RESOURCES

Wake Shield Facility Program

Demonstrate Fabrication in Space Vacuum of Critical Building Blocks for Advanced Semiconductor Development and Production

STS – 60, 69, 80

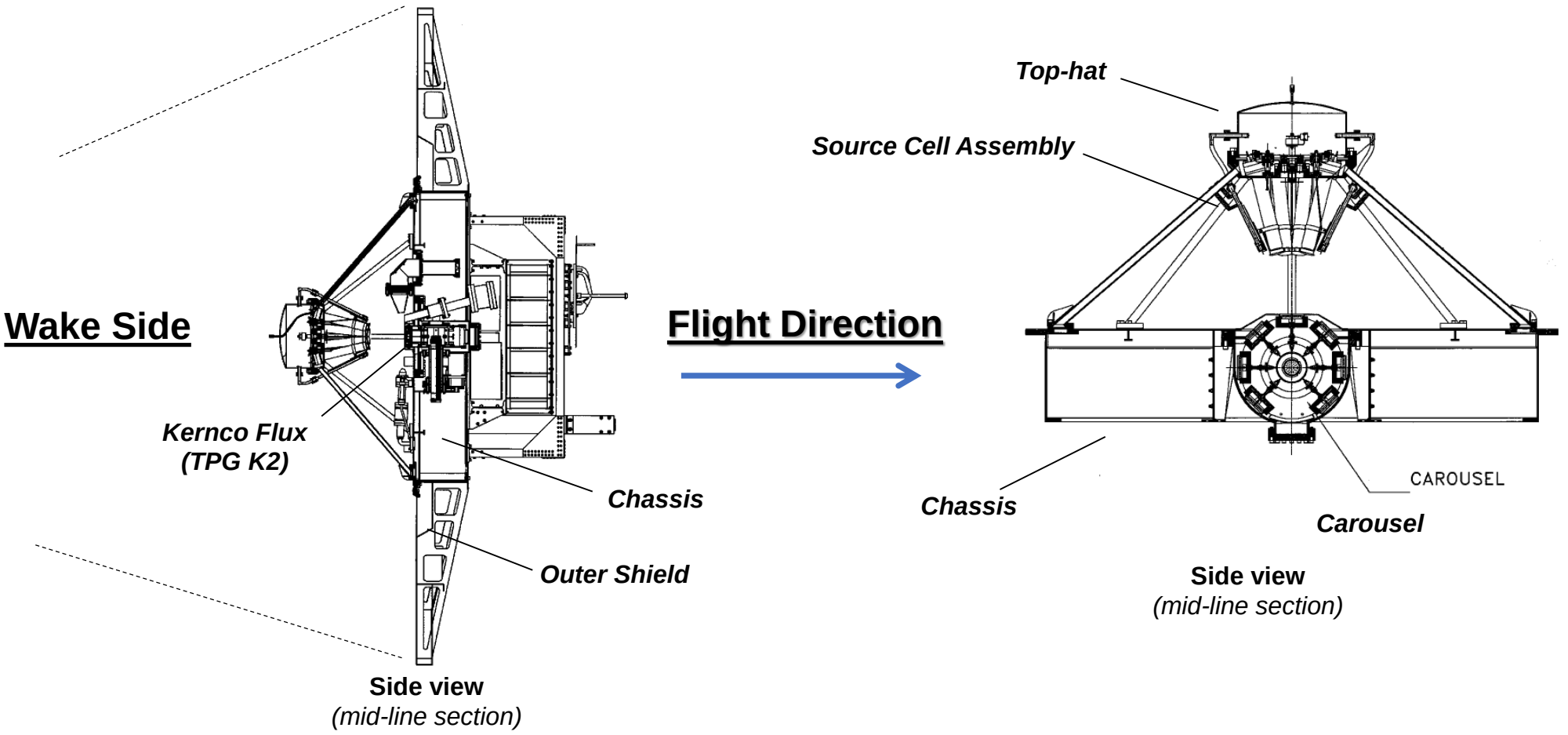
Free-flying platform for Thin Film Growth in Space Ultra-Vacuum



Vacuum Wake Formation –Redirect Atmospheric and Other Particles Around Spacecraft

LUNAR RESOURCES

Wake Shield Facility Program



Side view
(mid-line section)

Side view
(mid-line section)

LUNAR RESOURCES

Wake Shield Facility Program

Designed and Built at University of Houston

Assembly and Launched at KSC

LUNAR RESOURCES

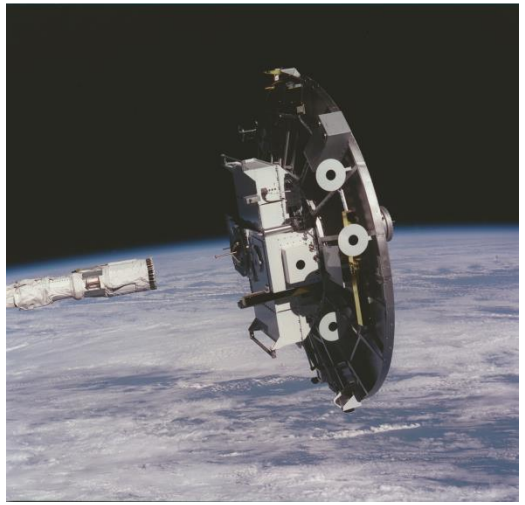
Wake Shield Facility Program

Unberth WSF from Payload Bay

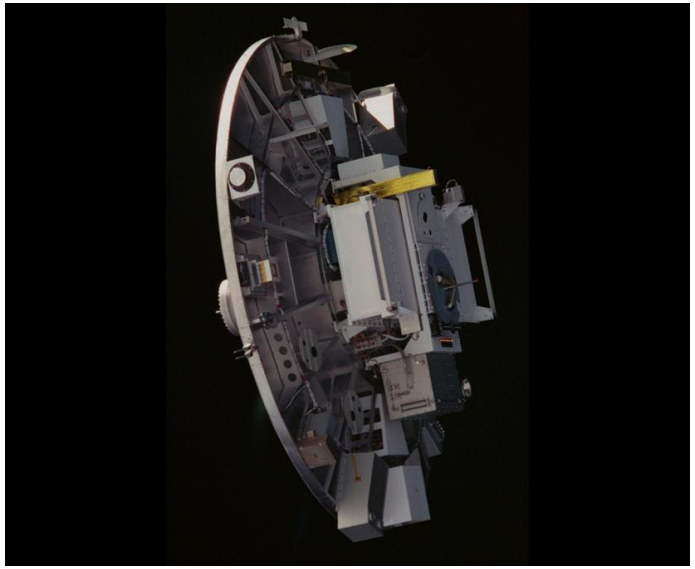
190 Nm circular orbit
Ram AO cleaning

LUNAR RESOURCES

Wake Shield Facility Program

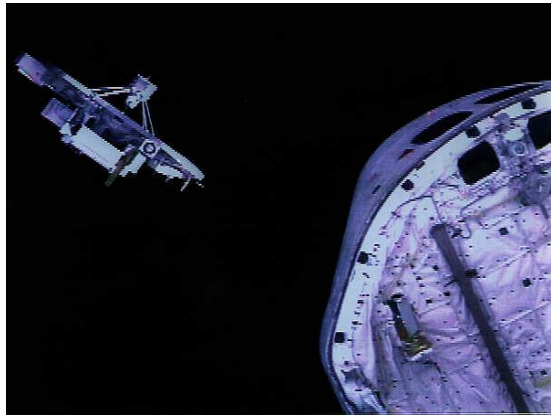


Deploy from arm



30 Nm separation
Vacuum Deposition Ops

Move Away from Shuttle with Nitrogen Thruster



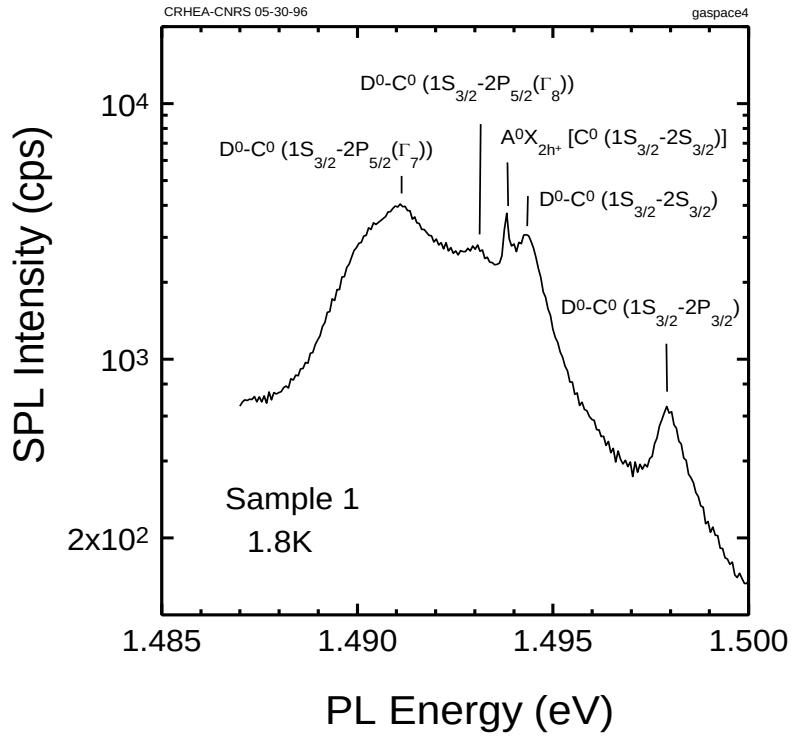
LUNAR RESOURCES

Wake Shield Facility Program Results

Results

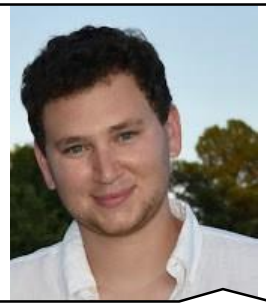
- Highest Quality GaAs Semi-Conductors
- Proved Vacuum Wake Concept
- Raised In-Space Vacuum Deposition Technology to TRL 7
- Advanced thin film fabrication and semi-conductor technology on Earth and Space

<u>Basis for LRI's Technology and Team to Fabricate Reflective Coatings In-Space to create Ulta-Large Space Mirrors</u>



Lunar Resources, Inc.

- **Founded: 2018 in Houston TX**
- **Heritage: Wake Shield Program**
- **Technology: In-Space Vacuum Deposition**
- **Products: In-Space functional materials**
  - **Coatings**
  - **Thin-Films**
  - **Semiconductors**



Elliot Carol
CEO

Dr. Alex Ignatiev
Chief Technical Officer

Dr. Peter Curreri
Chief Science Officer

Dr. Donald Sadoway
Director of Metallurgy

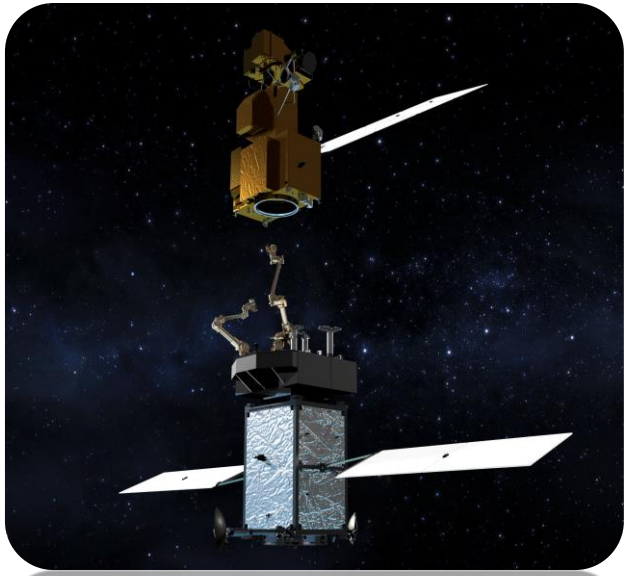
Dr. Alexandre Freundlich
Director of Material Deposition

LUNAR RESOURCES

In-Space Vacuum Deposition Applications

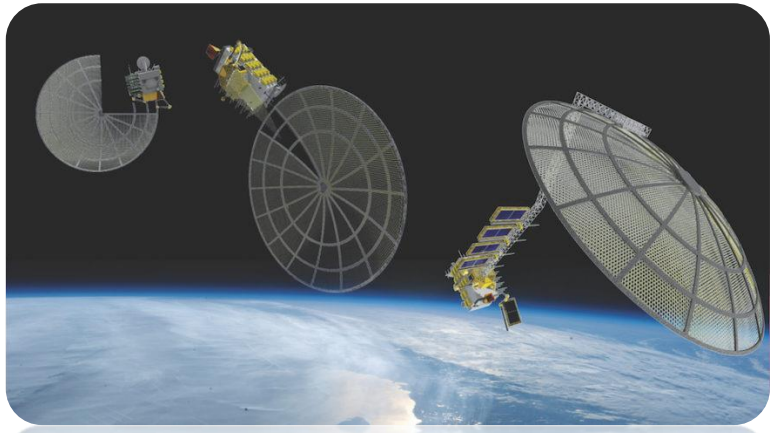
Satellite Servicing of Existing Space Asset

- Repair of Functional Coatings
- Restoration of Thin Film Materials
- Upgrade of Space Components



In-Space Manufacturing

- Mirrors
- Reflectors
- Antennas
- Radars
- Power Systems



LUNAR RESOURCES

Vacuum Deposited Products

Class	Materials/Product	Type
Class 1	Optical Reflective Coatings	Metallic Coating
	Infrared Reflective Coatings	Metallic Coating
	Ultra-Violet Reflective Coatings	Metallic Coating
	Anti-Reflective Coatings	Metallic Coating
	Anti-Radiation Coating	Metallic Coating
	Anti-Corrosion Coating	Metallic Coating
	Sensitivity Coatings	Metallic Coating
	Dielectric Coatings	Metallic Coating
	RF Coatings	Metallic Coating
	Thermal Coating	Metallic Coating
	Conductive Film	Metallic Coating
Class 2	Planar Antennas (Dipole)	Thin Film
	Conductive Wires	Thin Film
	Solar Cells	Epitaxial Thin Film
	Solar Sails	Thin Film
	Wave Pass Filters	Thin Film
	Band Pass Filters	Thin Film

Deposition Elements	
Ag	GaAs
Al	InCuSe
Au	K
Be	Mg
CdS	Ni
CdT	Si
Cr	Ti
Fe	Tin
Ga	Zn

And alloys…

In-Space Vacuum Deposited Optical Coatings

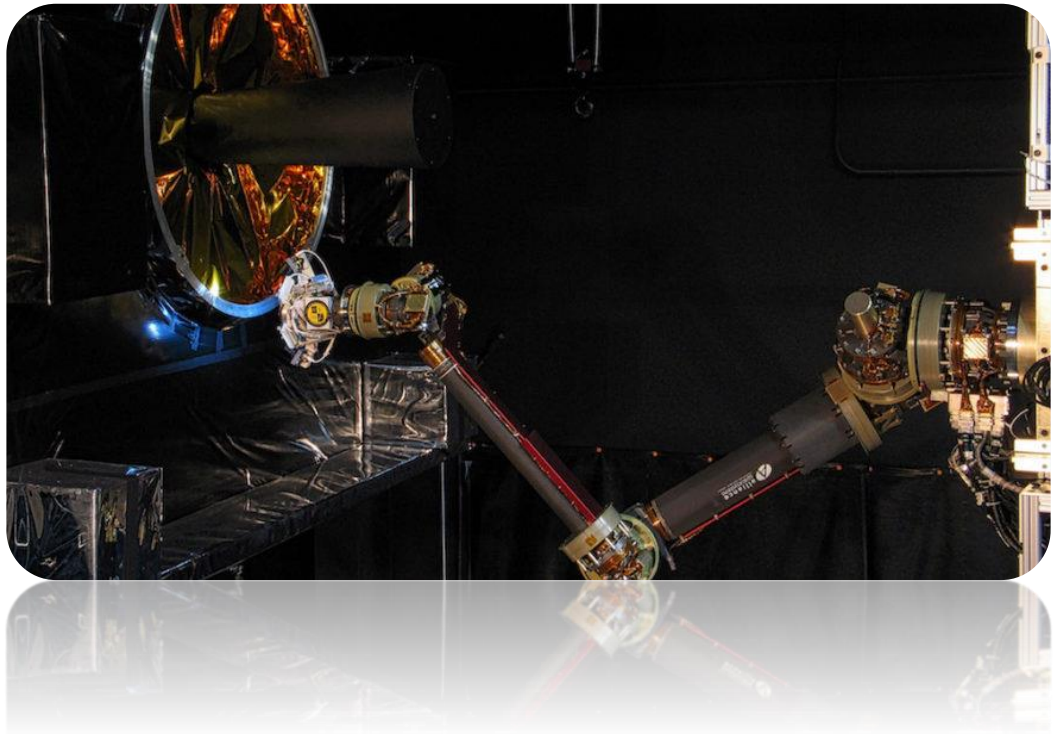
Direct Deposition of Mirror Coatings:

- Visible/UV (Ag, Al)
- Infrared (Au)
- Other (Be, Mg, Ti)

Substrate Material:

- Polymer
- Ceramic
- Metallic
- Hybrid (mesh)

Earth manufactured or in-space manufactured substrates



LUNAR RESOURCES

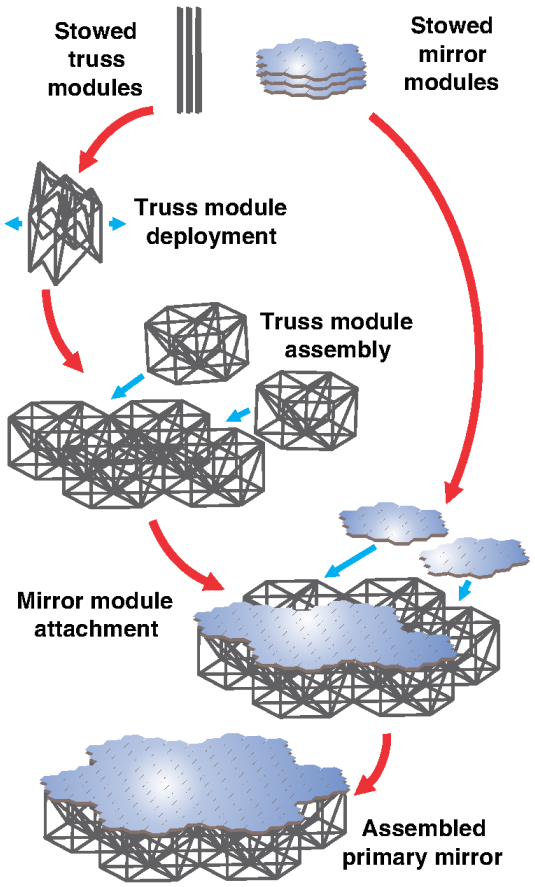
In-Space Vacuum Deposited Optical Coatings

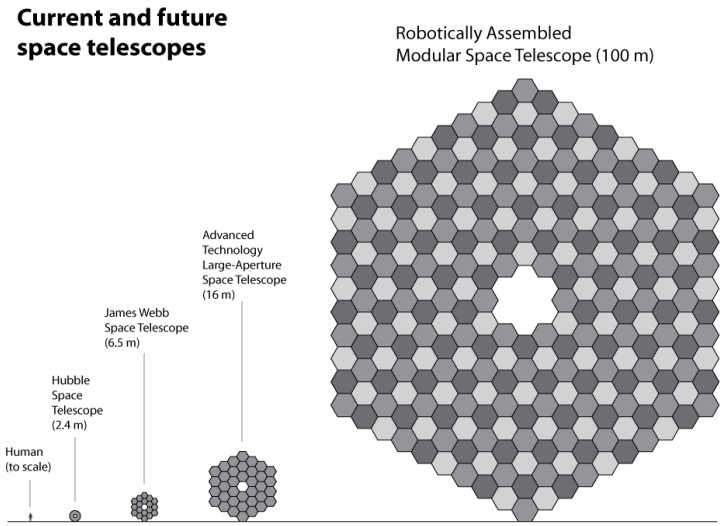
Advantages of Coating in Space:

- Ultra-Large Aperture Mirrors
- Eliminate Corrosion Issues
- Deposition of Pure Al
- Eliminate handling and packaging challenges
- On-Orbit Repair

Mirror Applications:

- Remote Sensing Satellites
- Visible Light In-Space Observatories
- UV and Infrared In-Space Observatories





LUNAR RESOURCES

Astrophysics Offering

Enabling Future Large-Scale Space Astrophysical Observatories by Fabricating Functional Materials In-Space

Overview

- Type: Coatings and Thin-Film Materials
- Size: 1m – +1000m in Diameter

In-Space Production Capabilities:

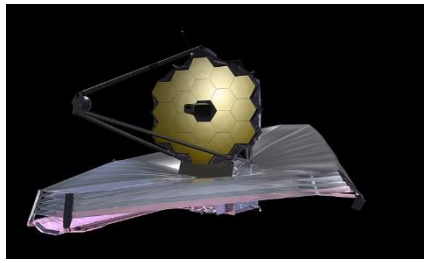
- Antennas
- Optical Surface Coatings
- Mirror Coatings
- RF Coatings
- Sunshield Coatings
- Starshade Coatings
- Solar Cells (and Semiconductors)
- Transmission Cables
- Thermal Surface Coatings

Products	Elements
Mirror Coatings	Ag, Al, Au, Be, Mg, Ti
Sunshield and Starshade Coatings	Al, Si, SiC
Solar Cells (Thin-Film)	CdS, CdT, Ga, InCuSe, Si
Solar Sail Coatings	Al, Si, SiC
Radio Antennas (Thin-Film)	Ag, Al, Ca, Cu, Mg, Au

In-Orbit Asset Servicing

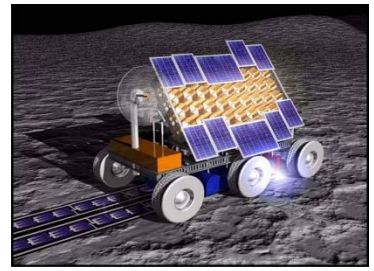
Satellites, Telescopes and Space Stations

Material Fabrication



Functional Materials and Coatings for Astrophysical Observatories

Infrastructure Construction



In-Orbit and Planetary Surface Infrastructure

LUNAR RESOURCES

Lunar Resource Inc., Contact information

Elliot Carol, CEO

Elliot@lunarresources.space

+1-646-455-8382

Dr. Alex Ignatiev, CTO

Alex@lunarresources.space

+1-713-202-6043

Houston, TX

www.lunarresources.space