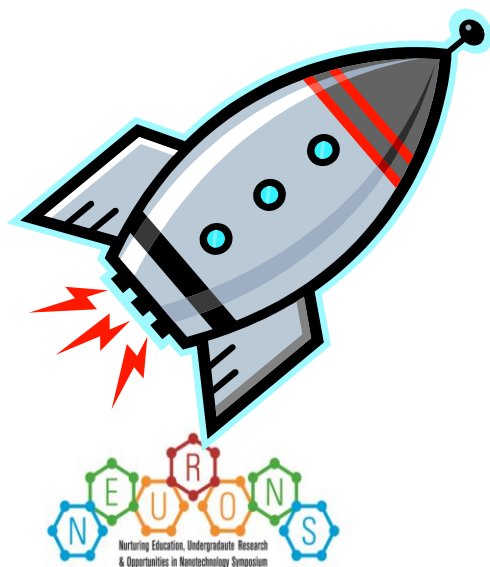




FROM UTPA TO NASA GLENN RESEARCH CENTER, A JOURNEY TO THE COOLEST JOB ON THE PLANET!



Dr. Maricela Lizcano
Research Materials Engineer
Ceramics Branch
Structures and Materials Division
NASA Glenn Research Center
Cleveland, OH

April 5, 2013



Educational Background

2004 B.S. Mechanical Engineering
Research: Nano Reinforced Polymeric
Materials - UTPA

2006 M.S. Mechanical Engineering
Research: Electrorheology of
 C_{60} Suspension Fluids-UTPA

2011 Ph.D. Mechanical Engineering
Research: Low-Temperature Processing of
Inorganic Polymers TAMU

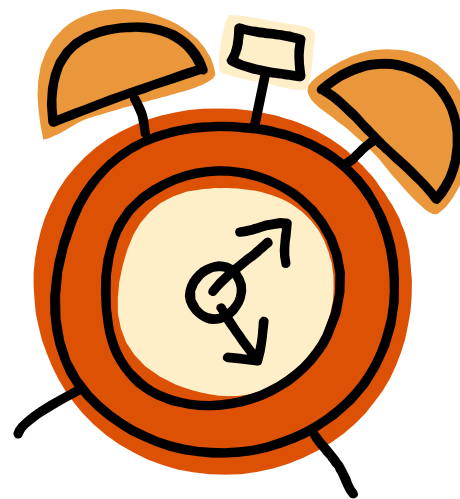




Growing Up...An Engineer in the Making

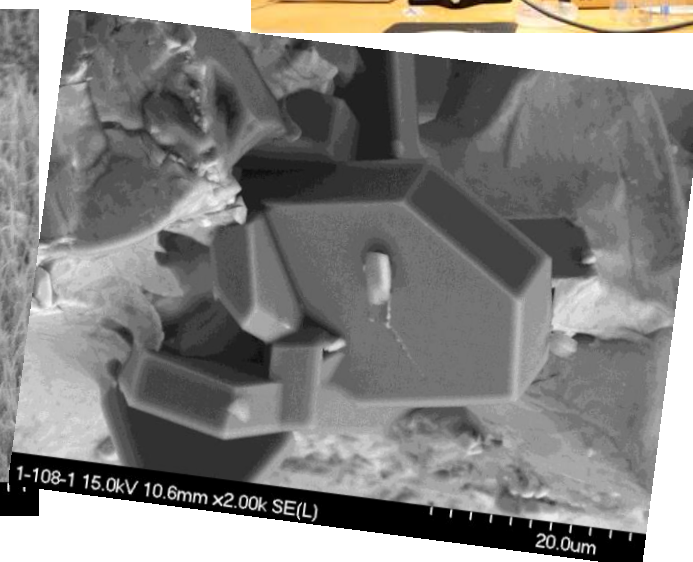
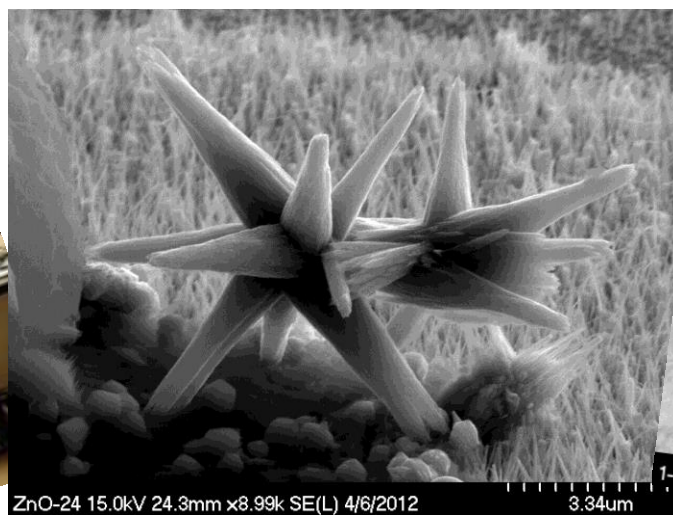
Dr. Lizcano grew up in Edinburg, TX. Her parents were born in Monterrey, Mexico. She has 7 siblings!

Ever since she was a child, she was fascinated by how things worked and was always trying to fix broken things around the house!



First Stop, UTPA College of Engineering and Computer Science A Smart Academic Investment

- AFFORDABLE
- Faculty with High Standard of Excellence
- State-of-the-Art Facilities



Zinc Oxide and Zintl Compound $\text{Ca}_5\text{Al}_2\text{Sb}_6$

SEM images taken by Jonathan Mackey PhD Student at University of Akron.



Pathways to Success

UTPA Undergraduate Opportunities

- Research Work Opportunities
 - Mechanical Engineering-Research with Faculty
 - Physics- Research with Faculty ,Instrumentation and Lab Instructor
 - Mathematics- Research with Faculty
 - Internships-NREL Internship and REU at UTPA and Vanderbilt University
 - HESTEC 2004 and 2005 Competition Coordinator
 - Scholarships-Lockheed Martin, LSAMP, Bridge to a Doctorate
- Faculty
 - Student/Teacher ratio
 - Dedication and Commitment
 - High Standard of Excellence
- Results
 - A **STRONG COMPETITIVE RESUME** Highlighting Academic Achievements, Work Skills such as Knowledge of Research Instrumentation, Data Processing and Analysis.





Next Stop, Graduate School!

Picking A School-My Choices

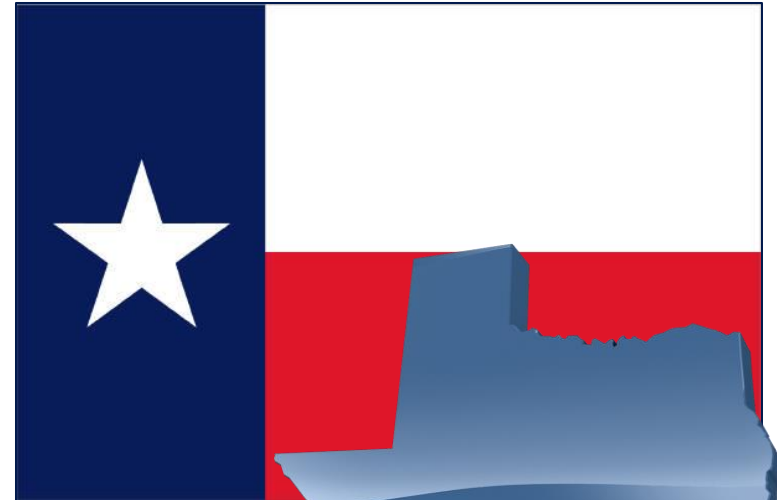
- University of Texas Austin
- New Mexico State University
- **Texas A&M University**
- University of Colorado at Boulder

Making A Choice

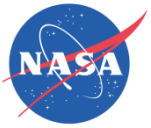
- Education Standard/Location/ **Cost of Living**
 - In-state Tuition
 - Available Scholarships
 - Best Opportunity

Applied to 1 school Texas A&M

- School Visit
- Accepted



There is NO DOUBT in my mind, I was very well prepared for the challenges of a PhD program due to my experience at UTPA.



The Day It All PAID OFF!

Monday, April 25, 2011 11:51 AM

NASA Glenn Ceramics Branch Monday, April 25, 2011 11:51 AM

From: "Grady, Joseph E. (GRC-RXC0)"

To: "marcilizcano@ [REDACTED]"

Maricela – I recently received your
the Ceramics Branch at NASA
ceramic components
cells. I
to talk
brief s

Thanks
Joe Grady
Chief, Cer
NASA Gle

NASA!?!!

rk in
1
give a





Final Destination, NASA Glenn Research Center Cleveland, OH



“Oh Yeah! That’s what I’m talking about right there!”





Technology Areas of Expertise at NASA-GRC

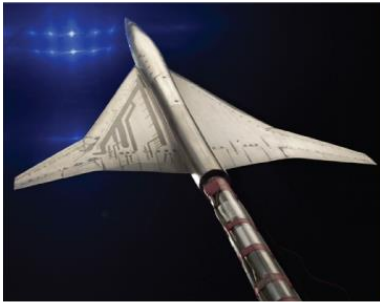
- **Materials**
- Human Health
- Electronics
- Environmental Emissions
- Sensors, Instrumentation and Communication
- Energy and Power
- Industrial Processes
- Software Applications
- Physical Sciences





NASA GRC Work Profile

Aeronautics Research



Science



Mission Support



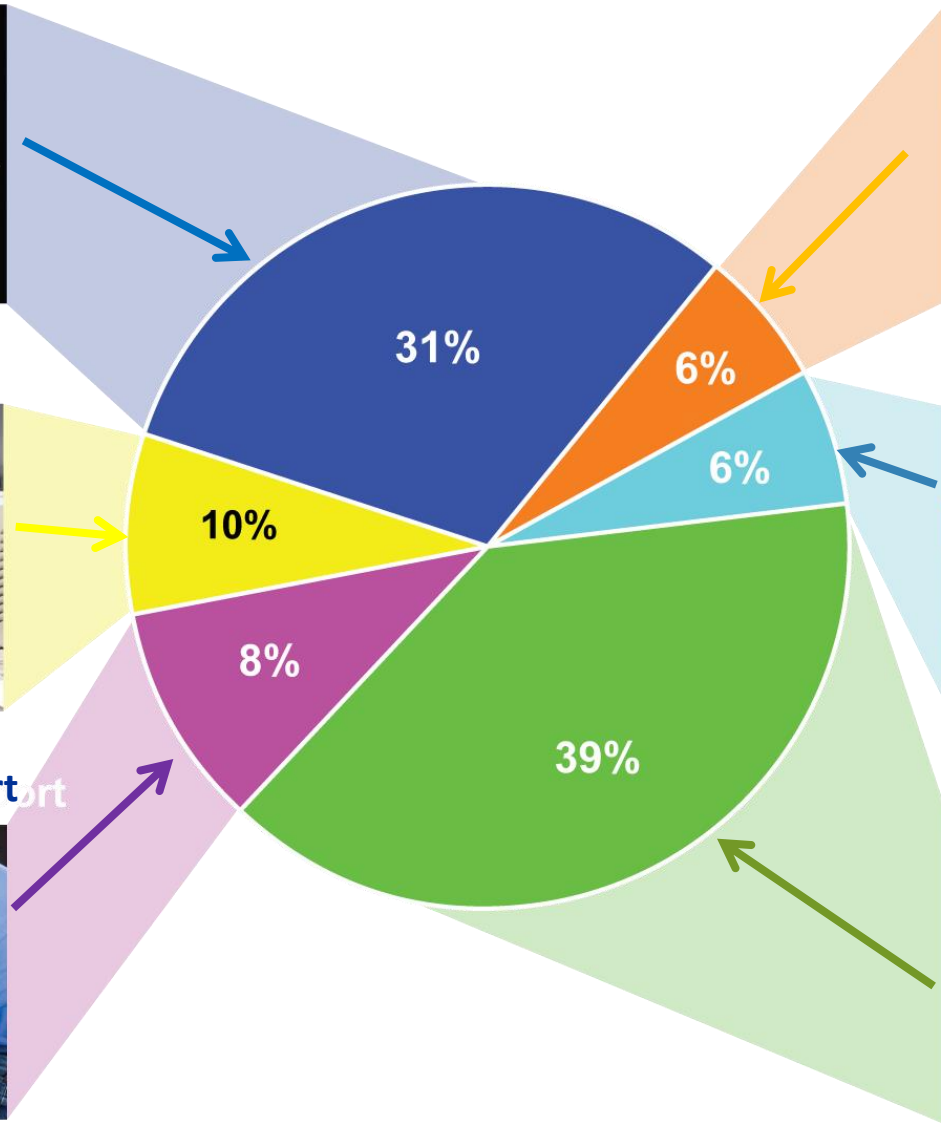
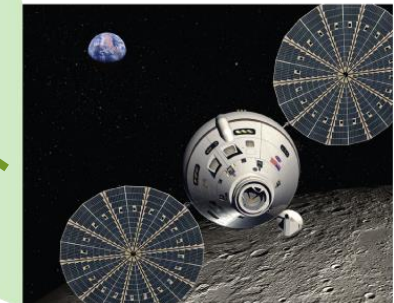
Space Operations



Cross Agency Support

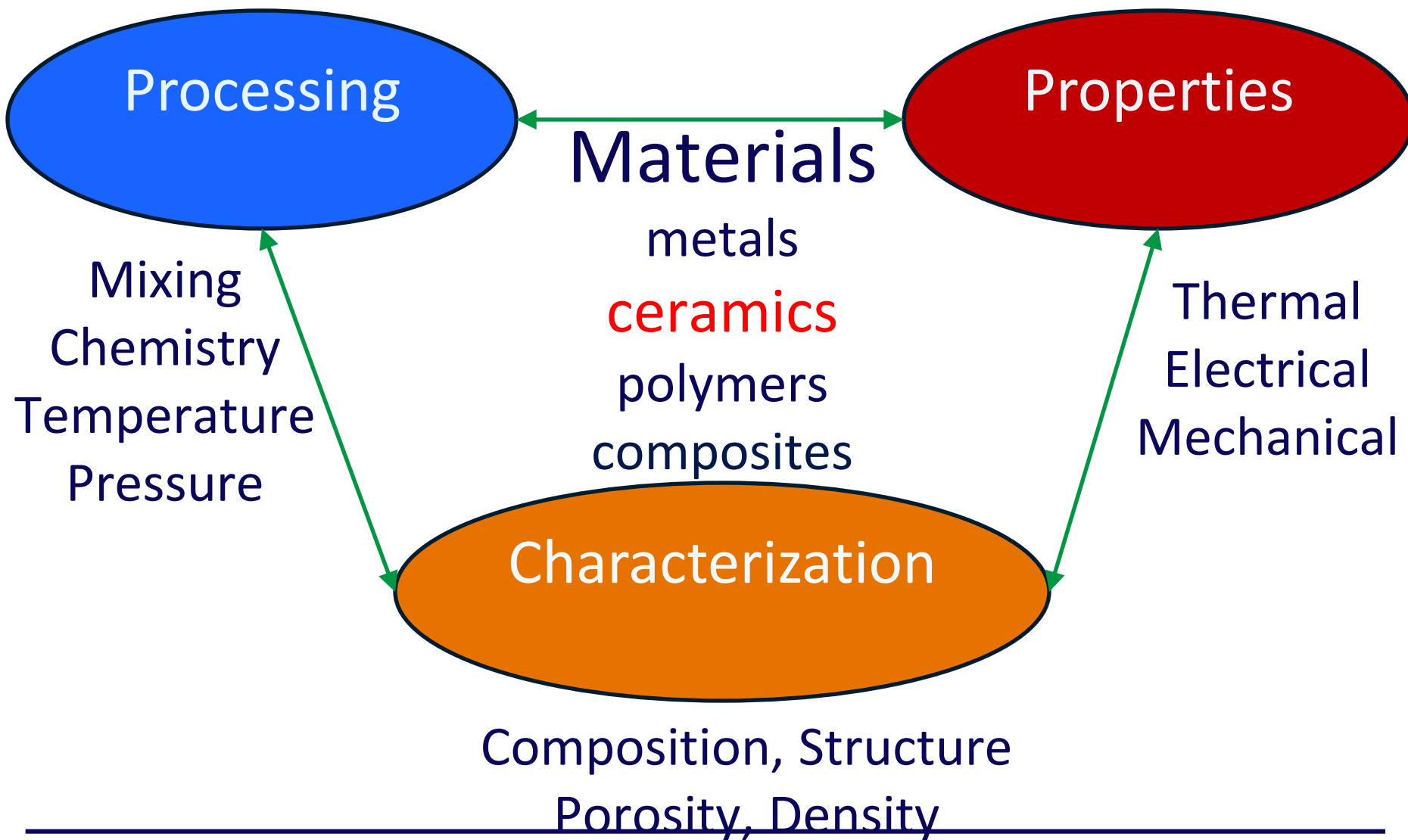


Exploration Systems



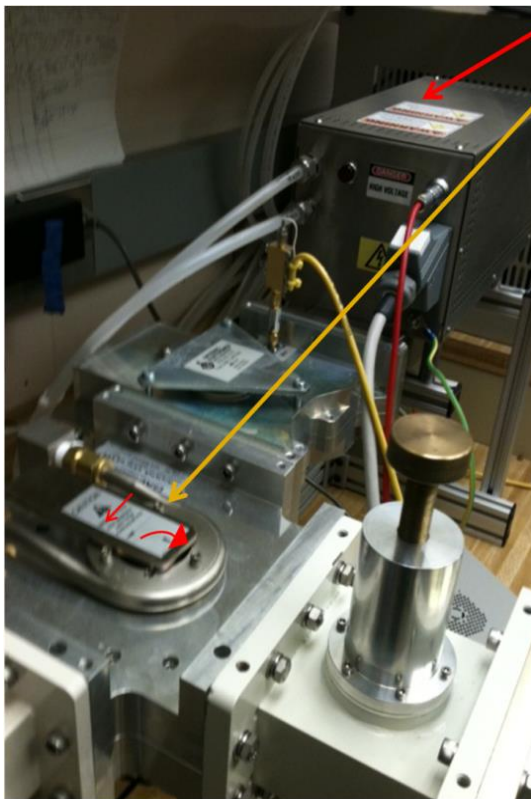


Job Title: Research Materials Engineer



Material Processing

Microwave Furnace

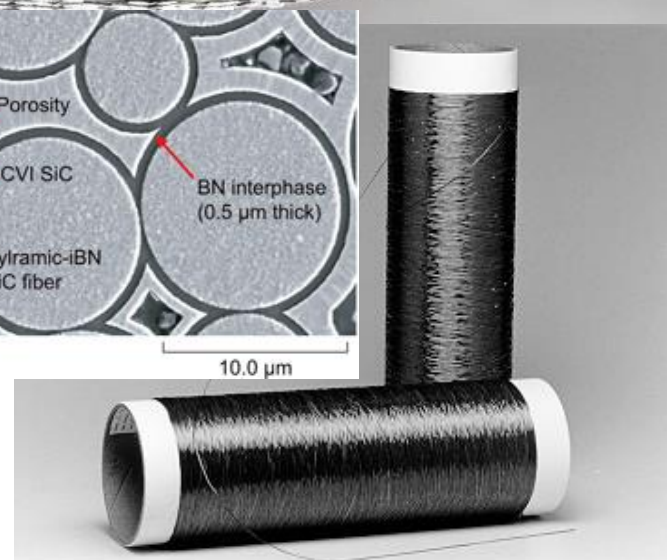
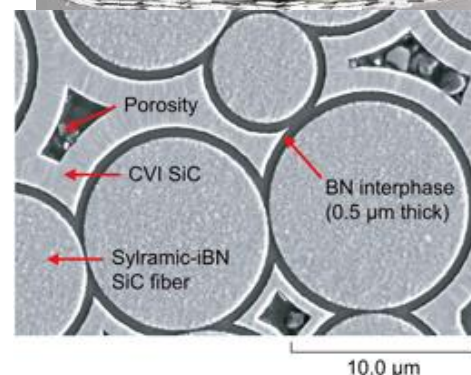


Magnetron Circulator



Electric Tube furnace

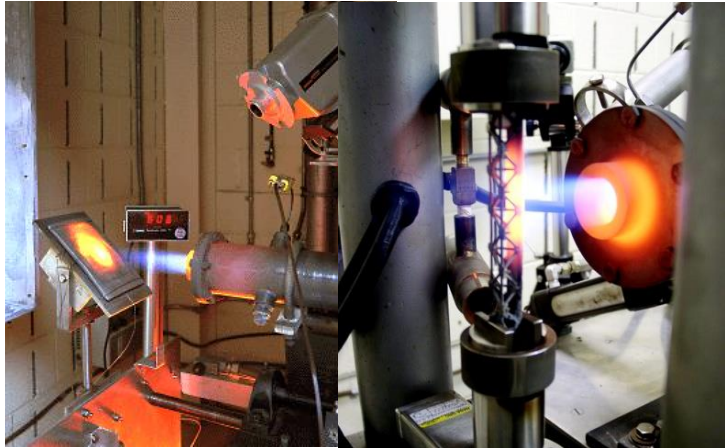
Fiber Weaving



Silicon Carbide Fibers www.nasa.gov 12

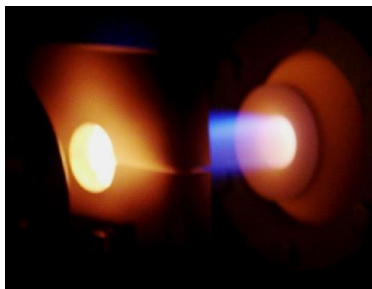
Material Property Testing

Hot Section Engine Environment



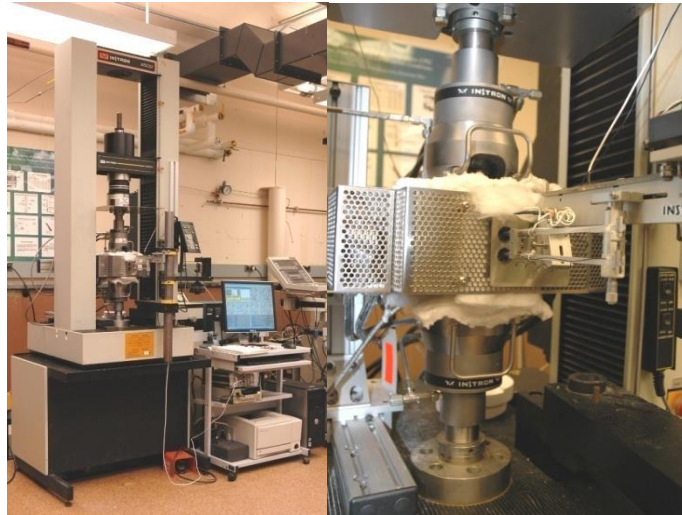
Mach 0.3 Burner Rigs

Jet fuel combustors: 700° to 2500°F exposure in oxidative or corrosive environments

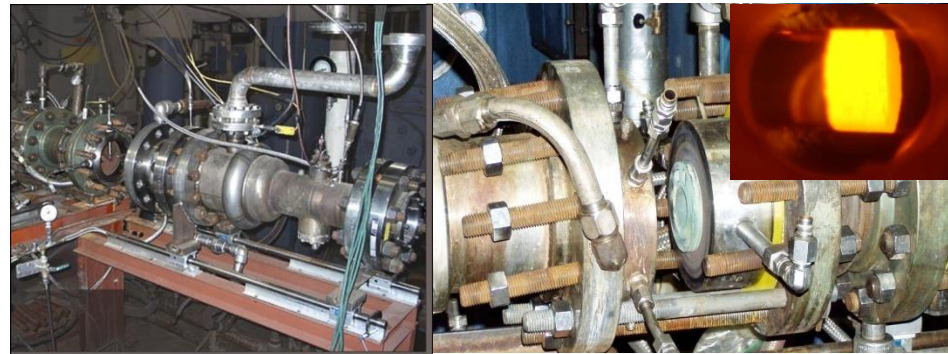


Erosion Burner Rig

Jet fuel combustor
Particle impingement



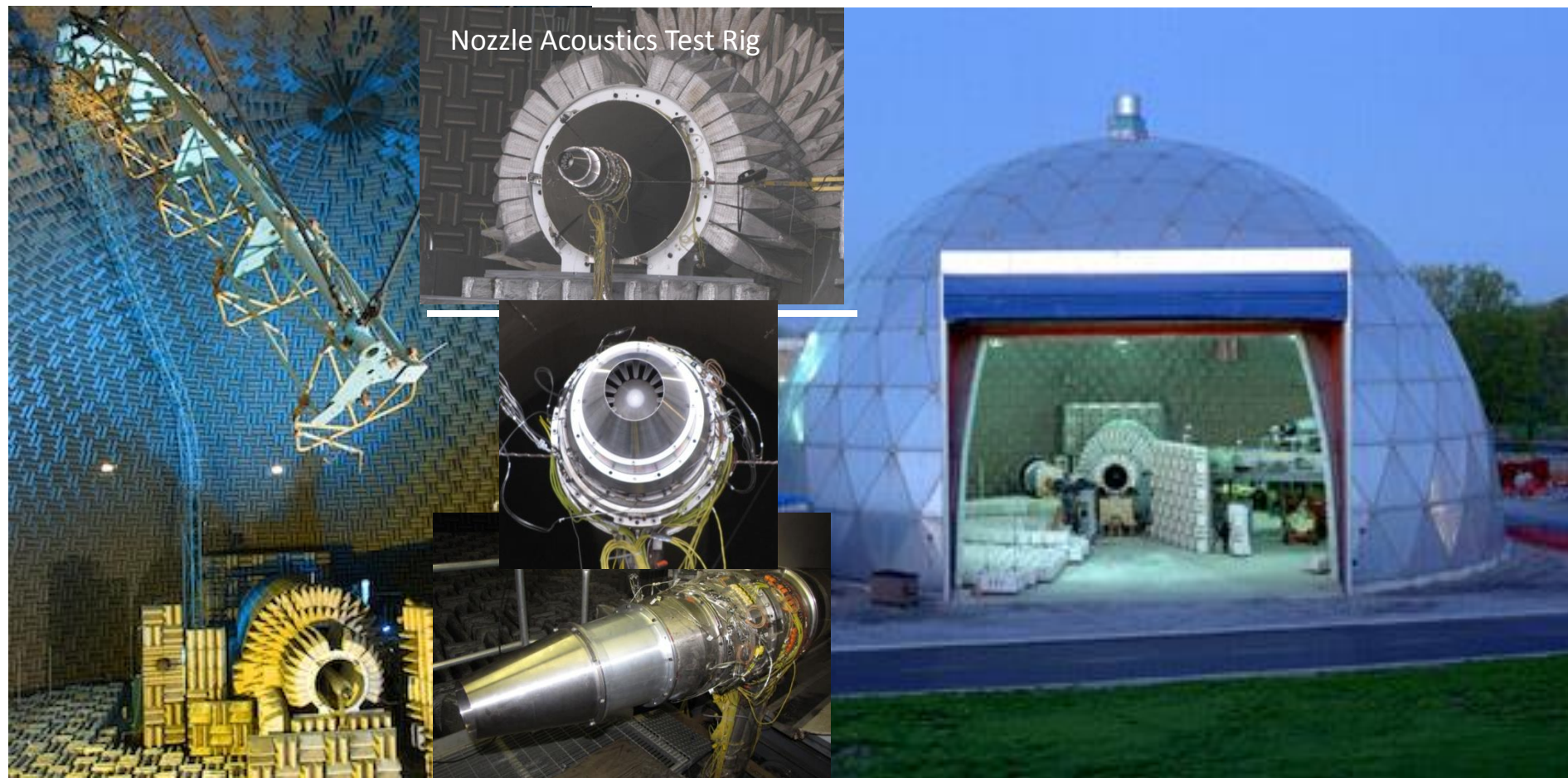
Mechanical Testing for long term durability testing to 3000°F in air with strain measurement



High Pressure Burner Rig

Jet fuel combustor
Gas temperatures of 1500 °F - 3000 °F
Test pressures between 5 - 10 atm.
Gas flow velocities 30 - 100 ft/sec.

Acoustic Testing of the CMC Mixer Nozzle



Aero-Acoustic Propulsion Laboratory (AAPL)

Anechoic wedges are on all surfaces inside the 65 foot radius geodesic dome prevent community noise or reflective noise from contaminating data.

Material Characterization

Microstructure Apollo Era Space Suit and Lunar Dust

9000X

EDS-B

X-ray Analysis of Lunar Dust Particle

Purpose: Preparation for extended stay on the moon.

1000X

Fiber samples removed from A Bean spacesuit (Apollo 12)

Sample from Left Knee

FEDCM samples A & B

Exposed area

"clean" Area under flag

Sample from Left Shoulder

50X

BeanSuit 2.0kV 11.6mm x1.00k SE(L) 2/5/2007

50

ApoCln_01 2.0kV 11.7mm x250 SE(L) 2/5/2007

200um

200um

BeanSuit 2.0kV 11.5mm x250 SE(L) 2/5/2007

200um

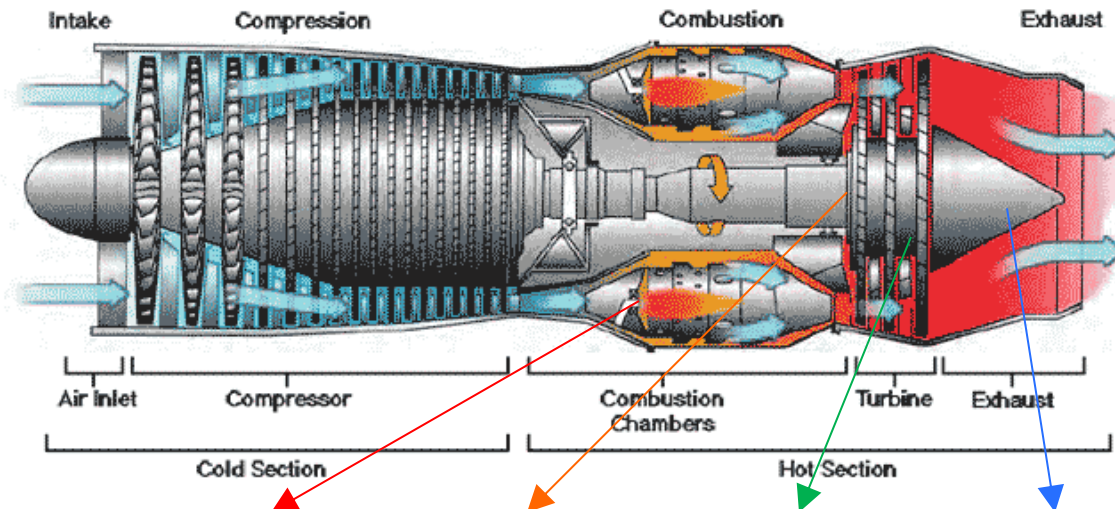
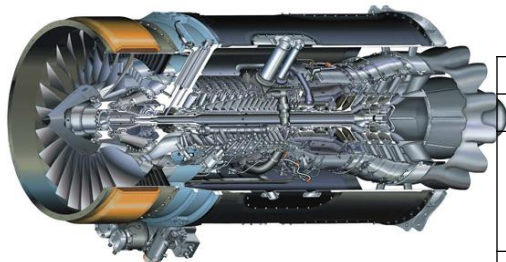
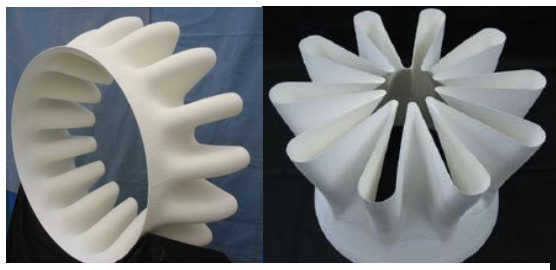
BeanSuit 2.0kV 11.6mm x50 SE(L) 2/5/2007

1.00mm

Teflon coated fiber glass

Ceramic Matrix Composites (CMC) ERA Goals: Reduced Aircraft Noise, Emissions and Fuel Burn

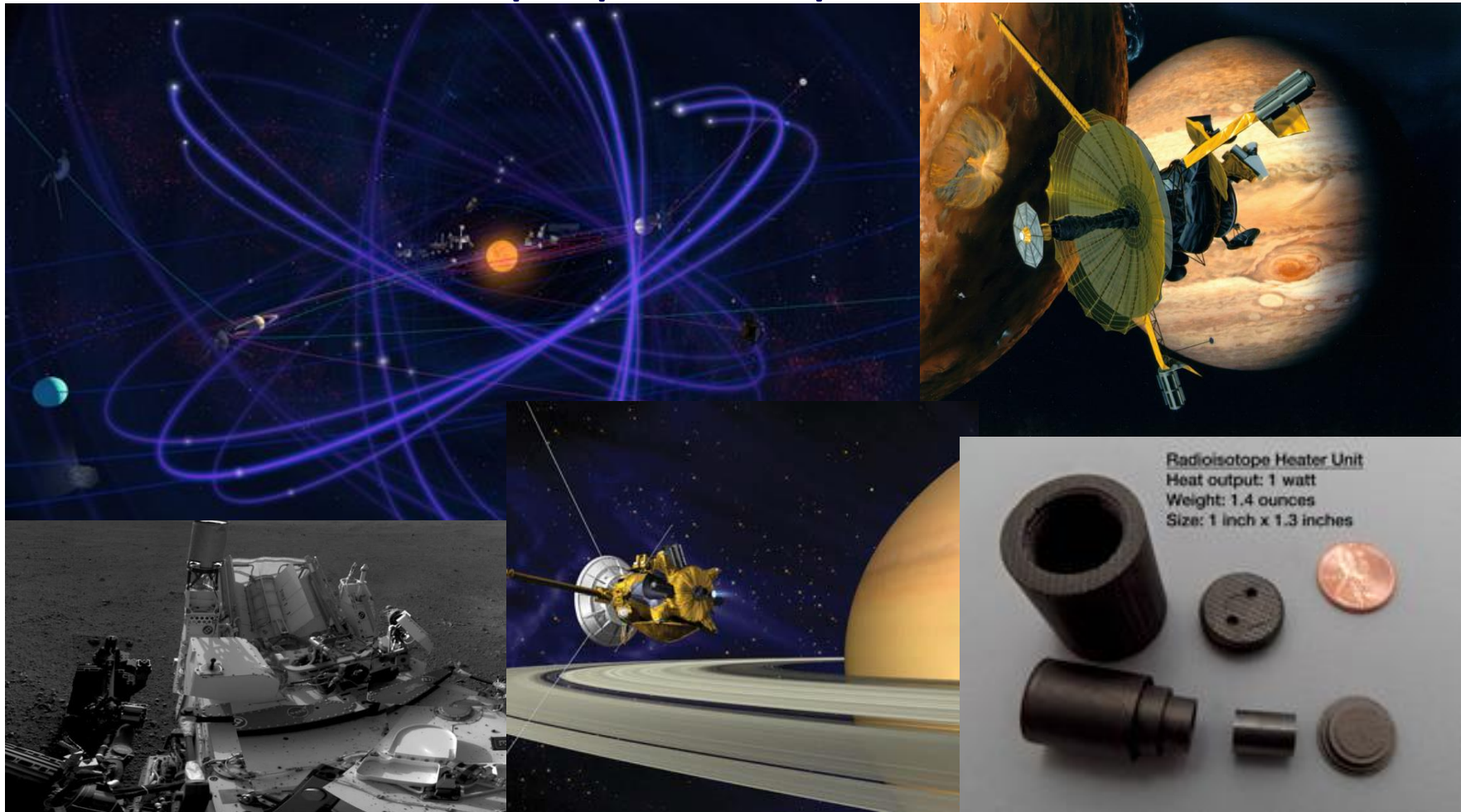
CMC engine component
reduce cooling air
requirements



	Combustor	High Pressure Turbine	Low Pressure Turbine	Exhaust Nozzle
Temperature	2200-2700°F	2400-2700°F	2200-2300°F	1500-1800°F
CMC System	SiC / SiC	SiC / SiC	SiC / SiC	Oxide / Oxide
Engine Benefit	<ul style="list-style-type: none"> • Reduced cooling • Reduced NOx • Pattern Factor 	<ul style="list-style-type: none"> • Reduced cooling • Reduced SFC 	<ul style="list-style-type: none"> • Reduced cooling • Strength / weight 	<ul style="list-style-type: none"> • Light weight • Noise reduction • Higher use temp
Challenges	<ul style="list-style-type: none"> • Durability • Attachment & Integration 	<ul style="list-style-type: none"> • Manufacturing • Durability • Attachment & Integration 	<ul style="list-style-type: none"> • Manufacturing • Durability • Attachment & Integration 	<ul style="list-style-type: none"> • Manufacturing • Durability

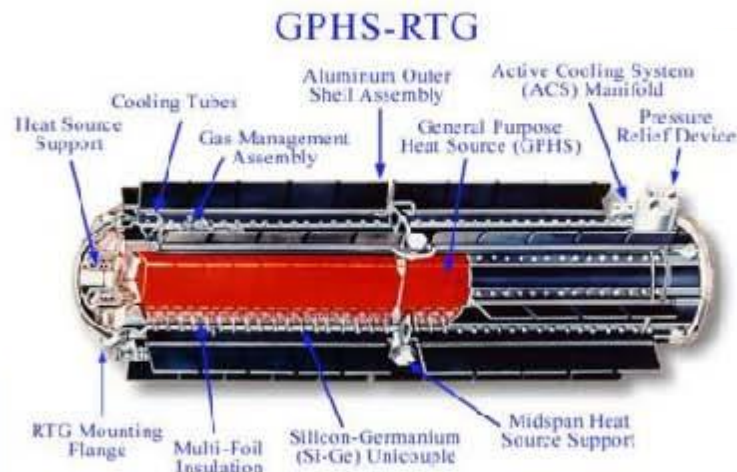
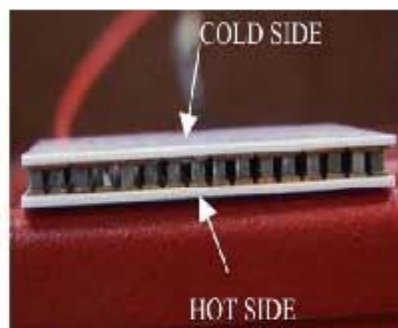
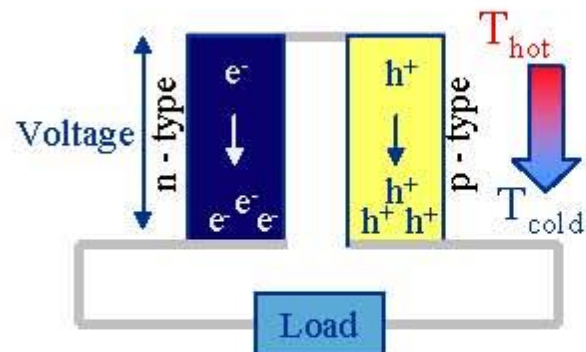


Radioisotope Power Systems (RPS) For Deep Space Exploration



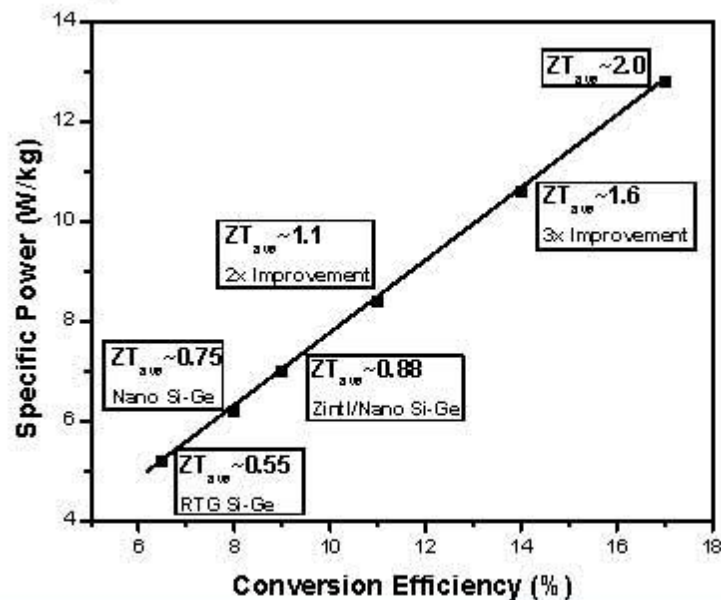
<http://solarsystem.nasa.gov/rps/galileo.cfm>

Heat to Electric Power Generation



Objective: High Conversion Efficiency
 • Reduces Mass, Volume & Cost

Space Power Generation



Waste Heat to Power

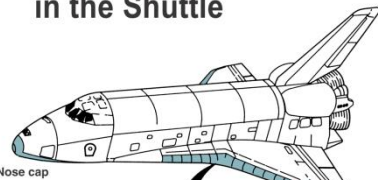
- Waste Heat is one of our most under utilized energy resources
- U.S.-energy consumption ~ 29 tera-kWh (10^{12})
Barrels of Oil – 170 giga-barrels (10^9)
- World-energy consumption ~ 120 tera- kWh (10^{12})
- 20-65 percent is lost in the form of heat
- Maximizes efficiency
- Reduces CO_2 emission

A photograph of a Space Shuttle Columbia being launched from the Kennedy Space Center. The shuttle is ascending vertically, leaving a massive, billowing plume of white and orange smoke and fire from its engines. The orbiter is attached to a white external tank and two white solid rocket boosters. To the left, the white metal service structure of the launch pad is visible. The sky is a clear, pale blue. The overall scene is one of powerful industrial engineering.

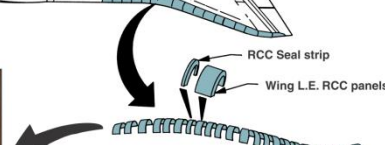
Engineering Materials for Space Flight

Thermal Protection Systems

Reinforced Carbon/Carbon (RCC) in the Shuttle



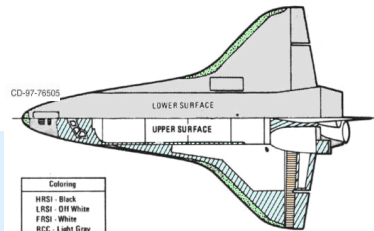
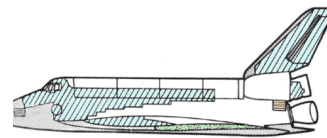
Nose cap



RCC Seal strip

Wing L.E. RCC panels

High Temperature Reusable Surface Insulation (HTRSI)



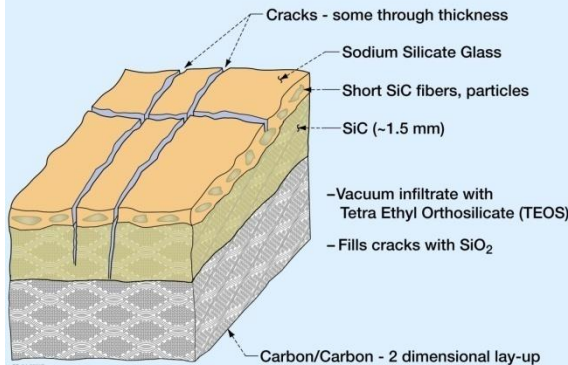
Legend for Thermal Protection System components:

- Reinforced Carbon Carbon (RCC)
- High Temperature Reusable Surface Insulation (HTRSI)
- Low Temperature Reusable Surface Insulation (LTRSI)
- Coated Nomex Felt Reusable Surface Insulation (FHSI)
- Metal or Glass

Element*	Area, sq m (sq ft)	Weight, kg (lb)
FHSI	322.7 (3481)	3.33 (7.33)
LRSI	254.6 (2741)	1914.2 (4225)
HTRSI	478.7 (5184)	4417.6 (9727)
RCC	38.6 (418)	1897.2 (4182)
Miscellaneous		918.5 (2025)
Total	1105.0 (11955)	6574.7 (14,364)

*Includes bulk insulation, thermal barriers, and clewouts.

Coated Reinforced Carbon/Carbon Composite



CD-34-00017

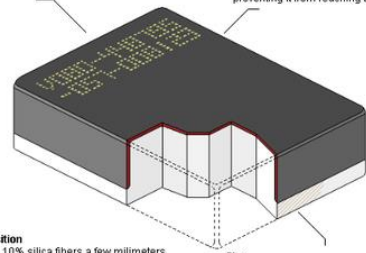
Coloring

- HTRSI - Black
- LRSI - Off White
- FHSI - White
- RCC - Light Grey

Thermal Protection System, Orbiter 102

Coating
The outer portion of a tile is covered with a black-glazed coating of borosilicate. These tiles do most of the coating job by shedding about 95% of the heat encountered. The remaining 5% is absorbed by the tile's interior, preventing it from reaching the orbiter's aluminum skin.

Identification number
Each tile has an identification number which tells batch and location. This number can be fed into a computer to produce an identical tile.



Composition
90% air, 10% silica fibers a few millimeters thick. The tiles feels similar to plastic foam. The silica fibers are derived from high-quality sand.

Glue
A silicon-rubber glue similar to common bathtub caulking, bonds a tile to a felt pad, that is in turn bonded to the orbiter's skin. The felt absorbs the stresses of airframe bending that could damage the tiles.

Re-entry Environment

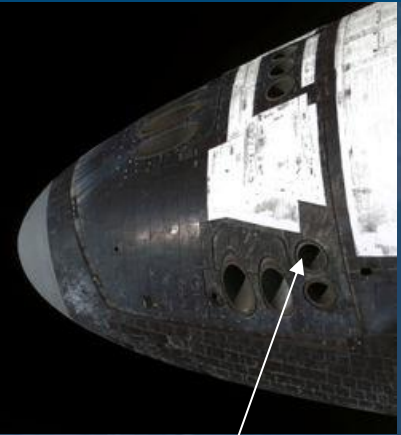


- Temperature to 2000 K
- Reduced pressure--0.005 to 0.010 atm
- Gases--O₂, N₂, CO₂
 - Shock leads to O, N and ions
- Short times ~15 minutes/re-entry
- Best simulated with arc-jet

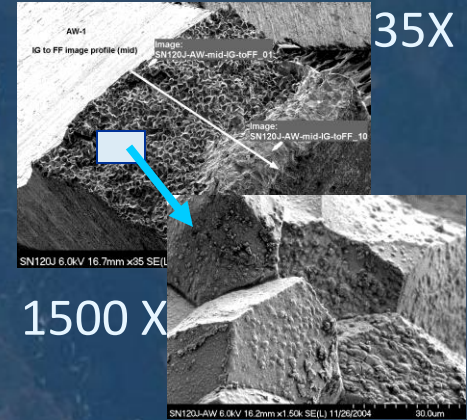




Cracks in flange
near bolt holes

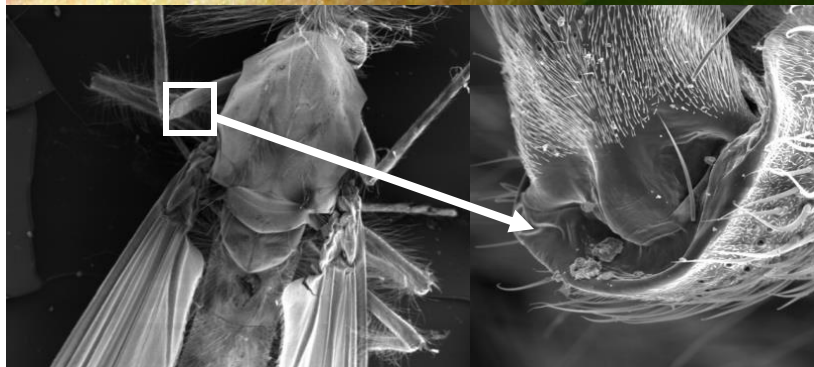
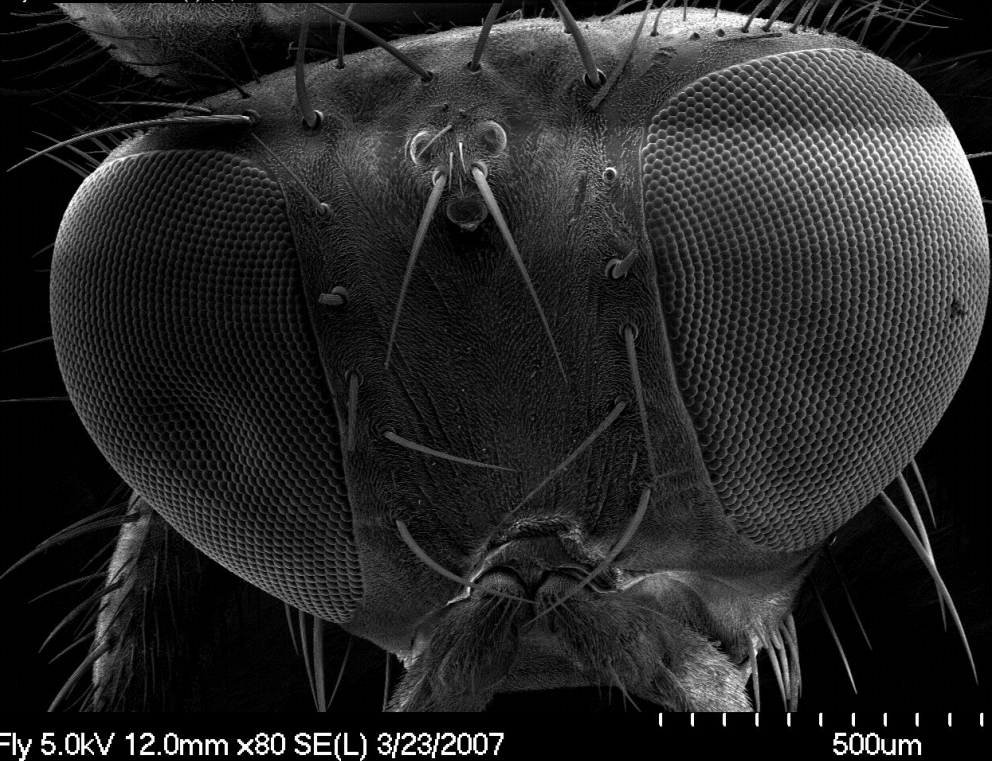
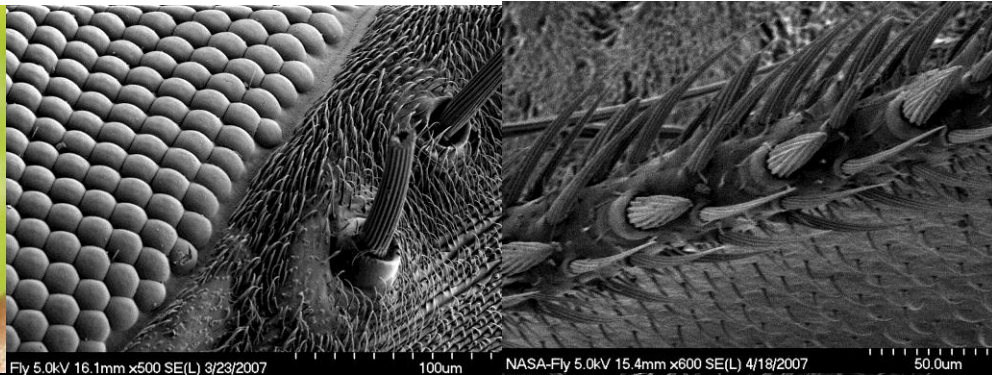


RCS Thrusters



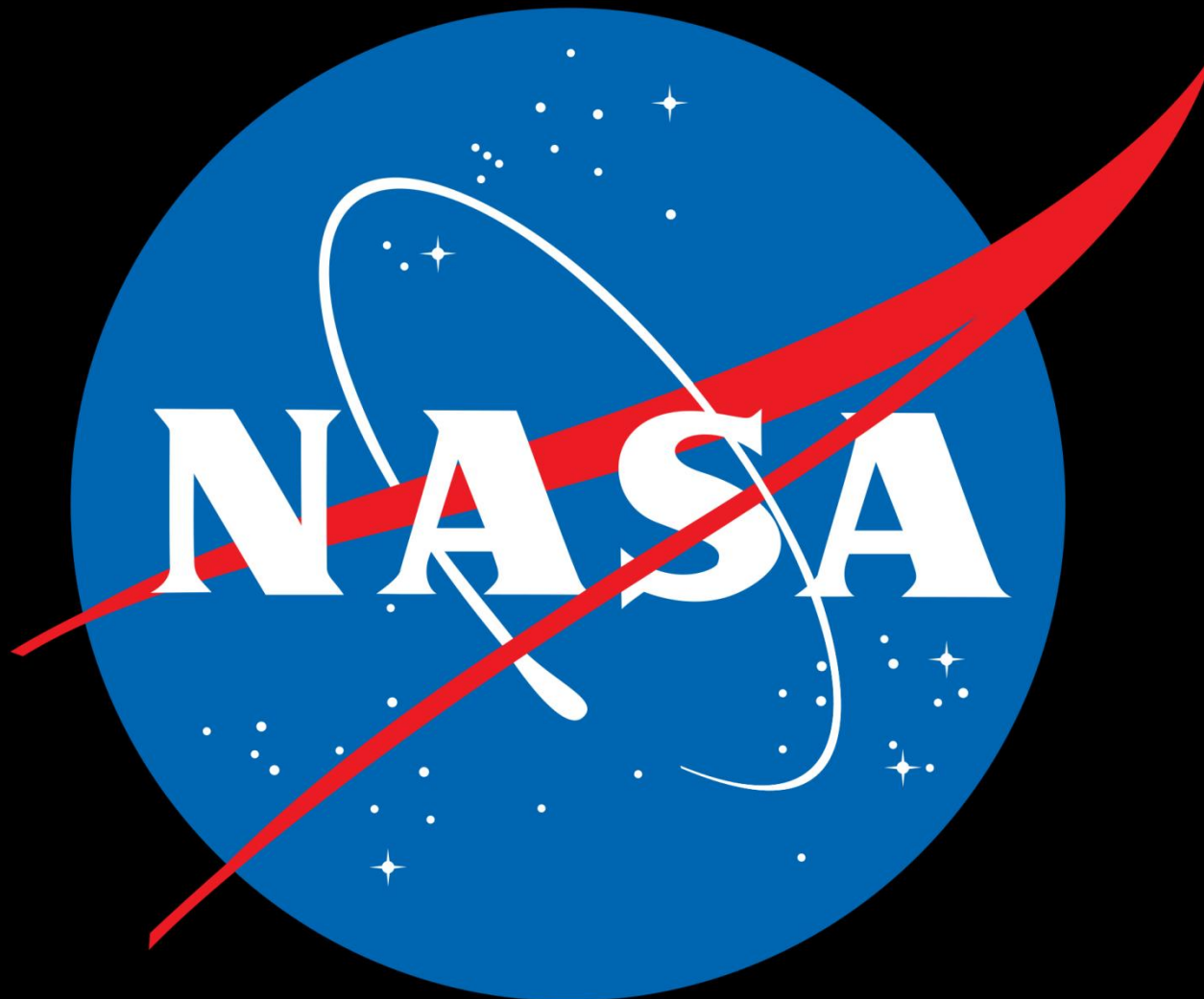
REACTION CONTROL THRUSTERS

Just for fun...Your Next Picnic!





THANK YOU!!!



QUESTIONS?