

Nanotechnology Impact

Driving the Materials Revolution

OECD / NNI Symposium

27 March 2012

L O C K H E E D M A R T I N

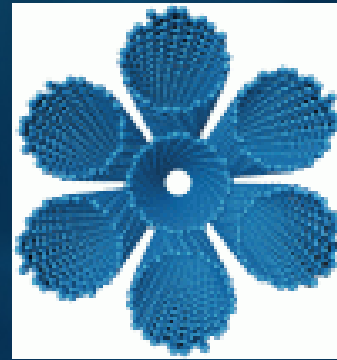


Travis Earles

Advanced Materials & Nanotechnology Initiatives

Nanotechnology Innovation

- **Control/manipulation/engineering**
- **Scale (~1-100 nanometers)**
- **Novel resultant properties**
- Breadth and speed of impact
 - Materials
 - Energy
 - Health and medicine
 - Electronics
 - many more...
 - Agriculture
 - Construction
 - Transportation
 - Consumer products
- Specific, intentional focus in the U.S. since 2001



**NATIONAL
NANOTECHNOLOGY
INITIATIVE**

www.nano.gov

Nanotechnology at Lockheed Martin

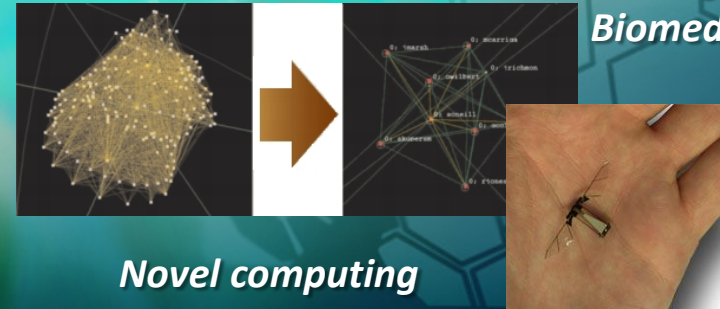
Aeronautics

Materials
Sensors



Information Systems & Global Solutions

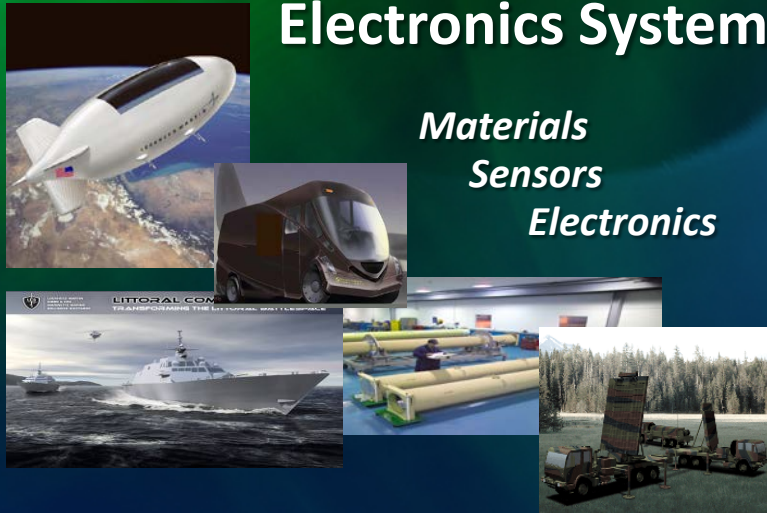
Control Algorithms
Biomedical



Novel computing

Electronics Systems

Materials
Sensors
Electronics



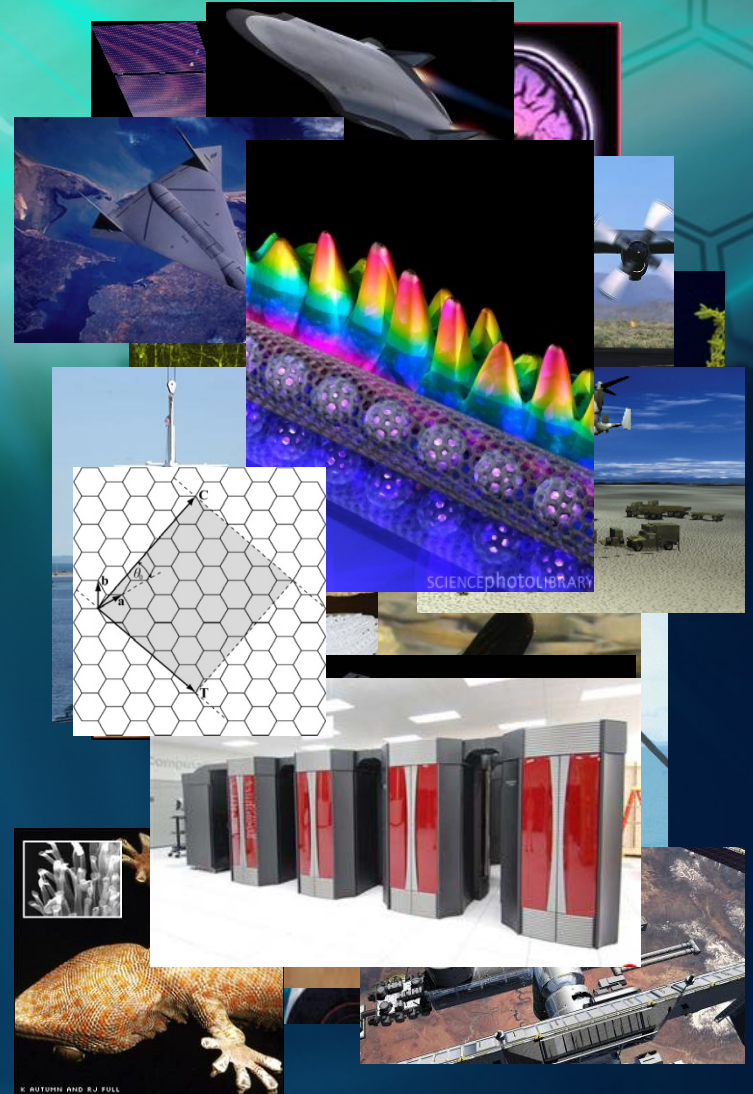
Space Systems

Materials
Sensors
Power

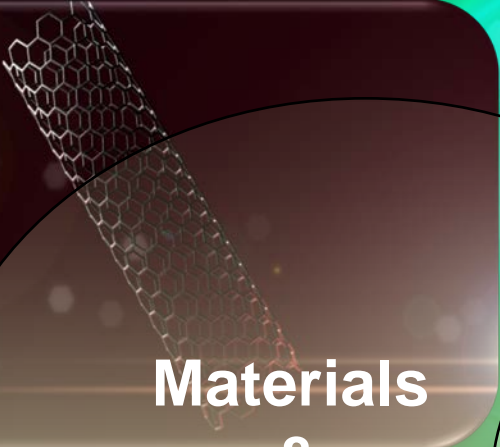


Focus Areas and Approaches

- **Materials and Structures**
 - Revolutionary composites and polymers
 - Affordable and sustainable manufacturing
 - Broader supplier base
- **Energy Conversion and Storage**
 - Solar coatings, flexible photovoltaics
 - Advanced batteries and supercapacitors
- **Sensors and Electronics**
 - Broad-band infrared
 - Chem/bio sensors
 - Flexible electronics
- **Modeling and Simulation**
 - Reduce cost, accelerate development
 - Understand results, provide direction
 - Create design tools
- **Harness The Power of Nature**
 - Biomimetics
 - Novel computational approaches and architectures
 - Adaptation and stealth




R&D Coordination and Support



**Materials
&
Structures**

A 3D model of a cylindrical structure with a hexagonal mesh pattern, representing materials and structures.

**Modeling
&
Simulation**



**Sensors
&
Electronics**

A satellite in space with solar panels, representing sensors and electronics.



Energy

A wind turbine in a desert landscape, representing energy.



Structures

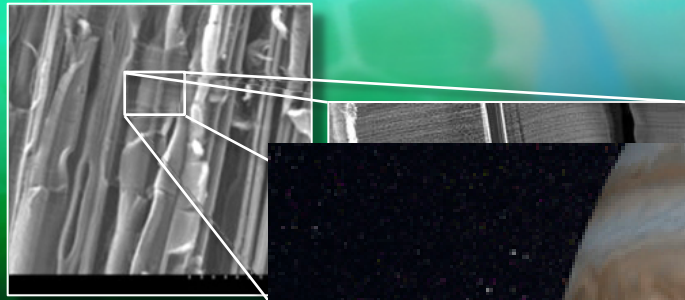
- **Need:** Light weight material that leverages low cost manufacturing processes to bring producible and affordable solutions for complex designs.
- **Solution:** Best-in-class ultra light weight and affordable structural thermoplastic enhanced with nanoparticles improves
 - mechanical properties
 - thermal stability
 - electrical conductivity
 - processability



Injection Molded Wing Tip on F-35

Multifunctional Materials

- Carbon nanostructures (CNS) are grown directly (infused) on surfaces in a continuous, in-line, production scalable process for glass, carbon, ceramic, metals

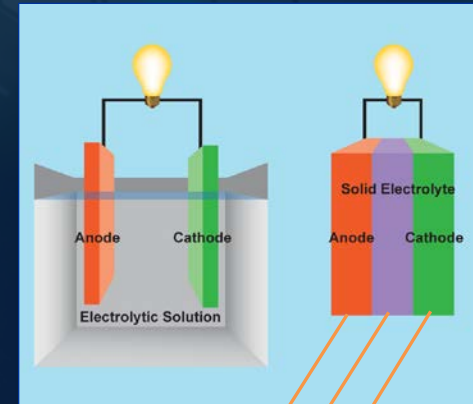


Energy Storage and Efficiency

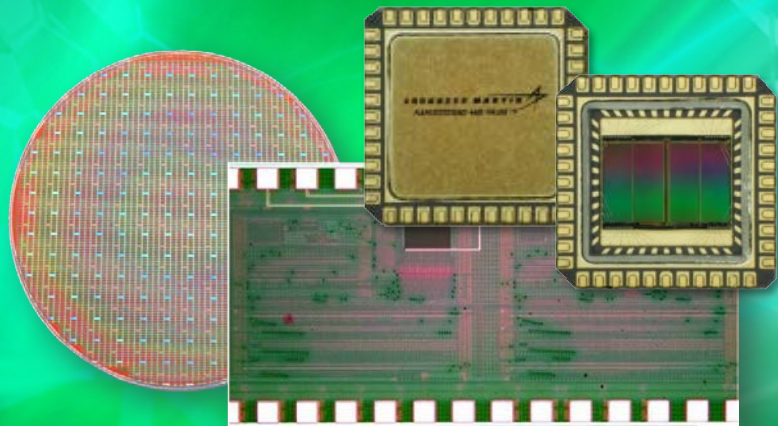
- Solid-state lithium-ion batteries (high capacity, long life)



Solid Batteries Are More Robust and Impact Safe

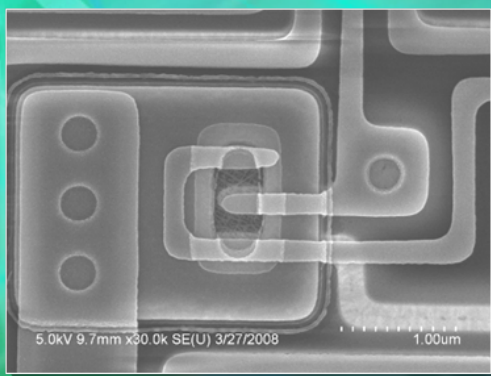
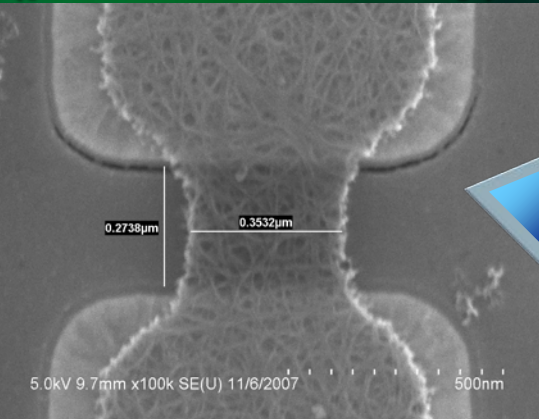


Electronics and Sensors



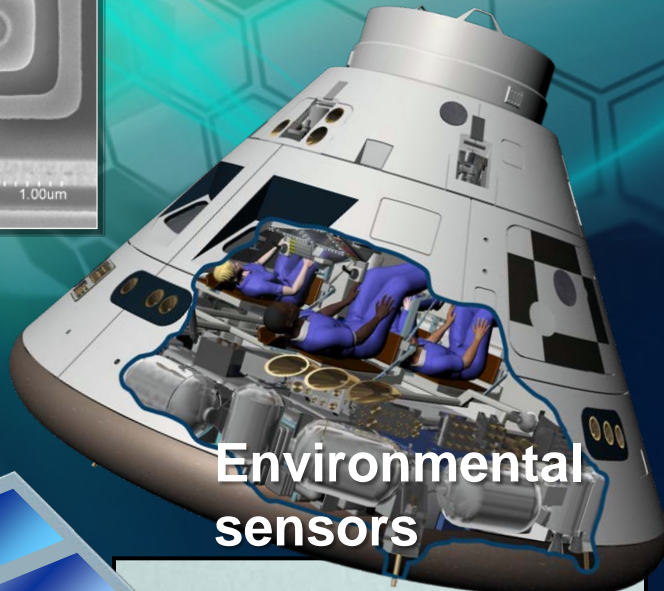
Memory – non-volatile / L2 cache (rad-hard)

Photon sensors (platform flexibility)

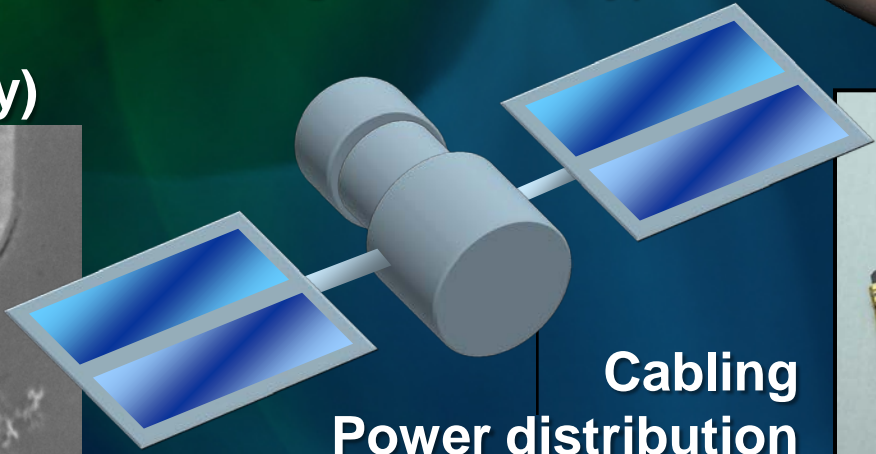


FPGAs (reprogrammability)

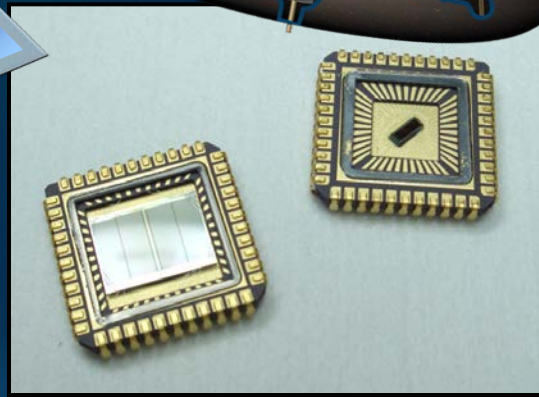
Complimentary logic (rad-hard, low power)



Environmental sensors



Cabling Power distribution



Thermal management (efficiency) *Lockheed Martin Nanosystems*

Why we do what we do

- Global security
- Geopolitical stability
- Economic prosperity



How

PARTNERSHIP

Discovery > Development > Deployment

INNOVATION

