

# National Security Science & Technology Needs



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**Critical National Needs in New Technologies:  
Opportunities for the Technology Innovation Program**

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# National Security Concerns

Nuclear Weapons

Nonproliferation

Energy

Nuclear Power

Homeland Security

Supporting the Warfighter

Science at Risk





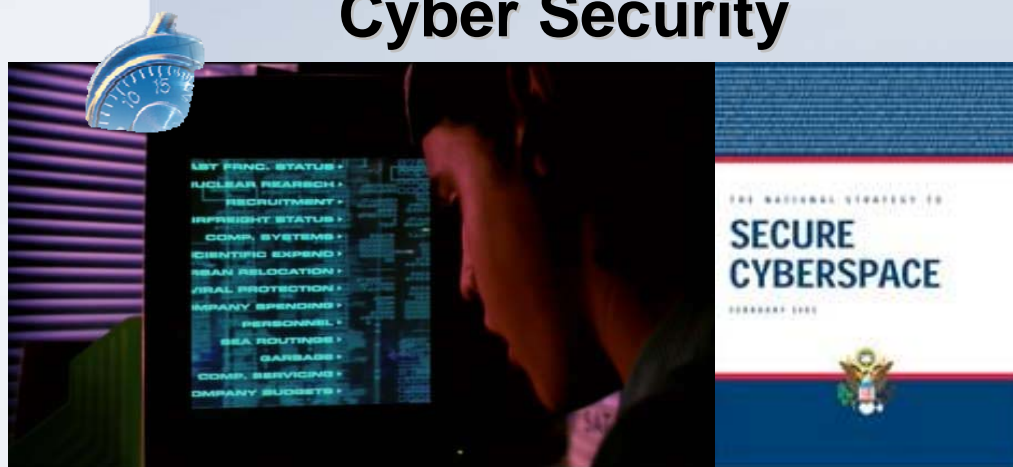
# Future challenges are varied and complex



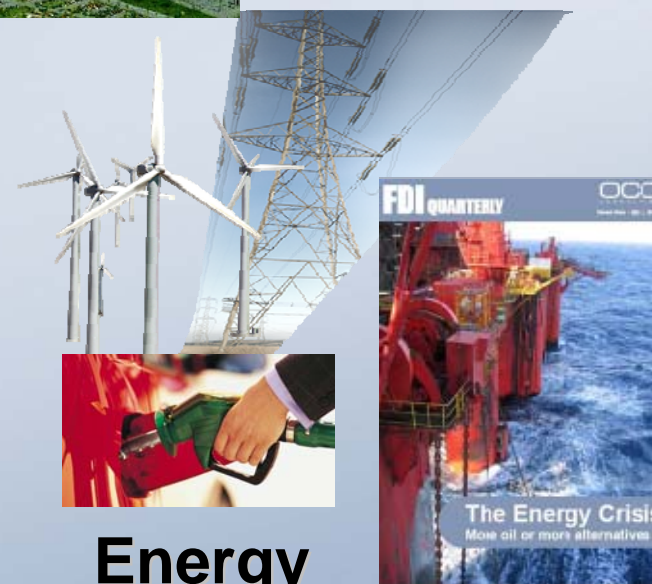
**WMD**



**Nuclear  
Surety**



**Cyber Security**



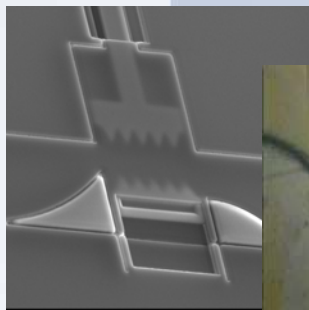
**Energy**

# Critical National Security Needs

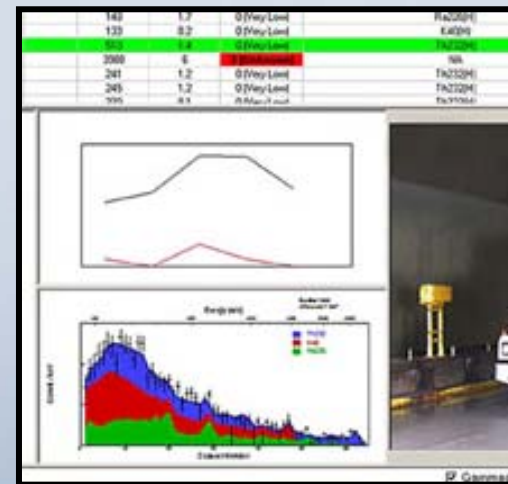
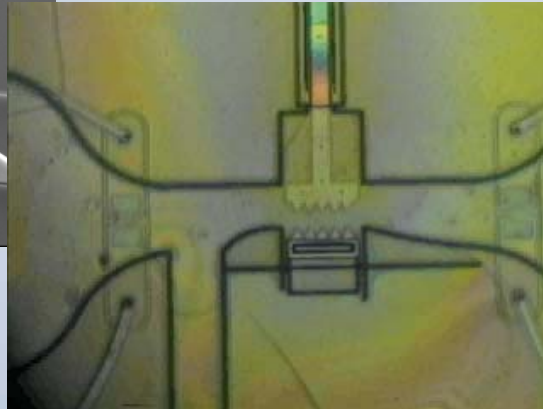
## – Prevent WMD –

### CBRNE Sensors:

- Chemical, Biological, Radiological, Nuclear & Explosive
- Sense, decide, act & communicate
- Provide pre-symptomatic medical screening diagnostics



Cell Lysing



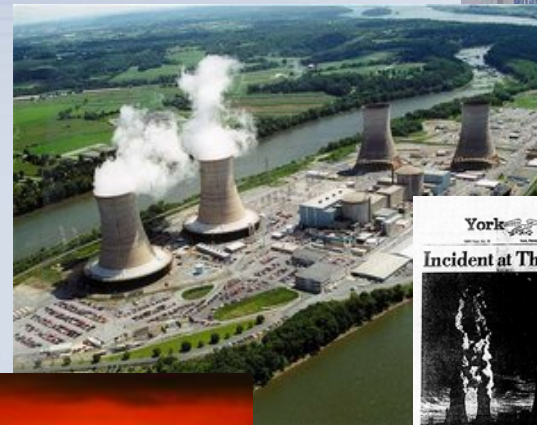
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# Critical National Security Needs

## – *Ensure Nuclear Surety* –

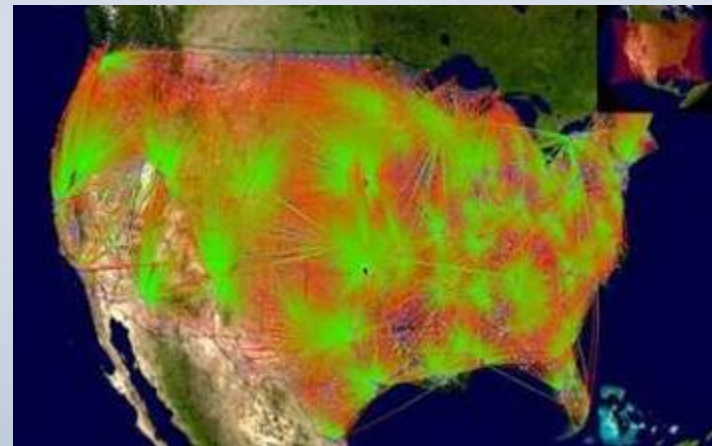
- Integrate safety and security
  - Nuclear weapons, power, and nonproliferation all together
  - Material and facilities
- Advance counter nuclear and radiological terrorism



# Critical National Security Needs

## – Secure Cyber Space –

- Trust
- Resilience
- Attribution
- Simulation

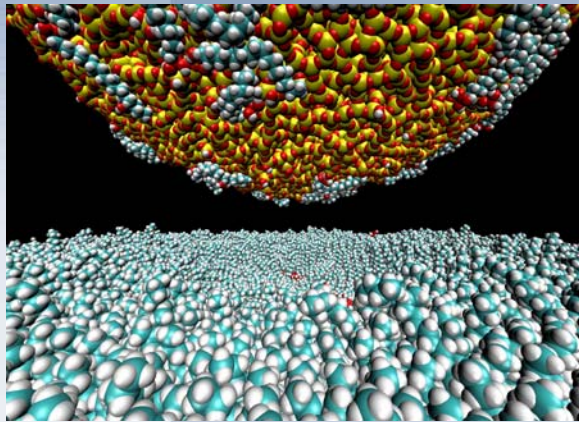




# Critical National Security Needs

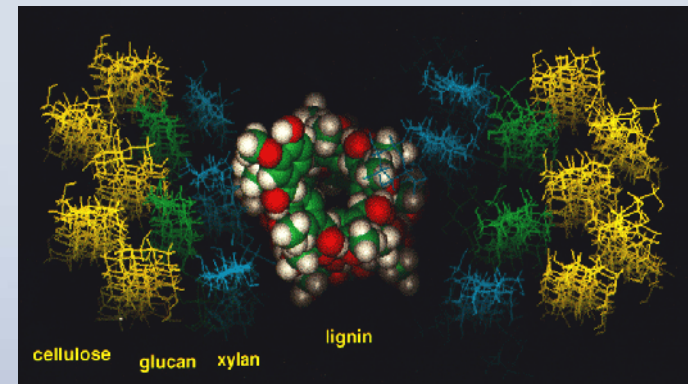
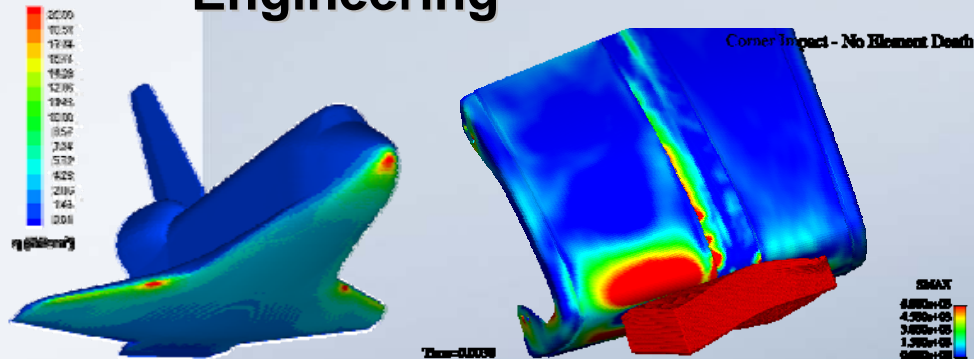
## – Enabling Simulation Tools –

### Science



- Develop and deploy scalable informatics platforms and algorithms
- Accelerate innovation through pervasive computational simulations

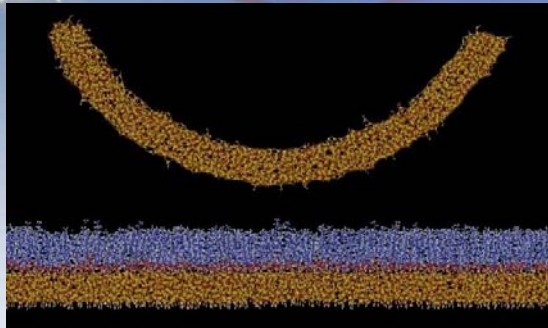
### Engineering



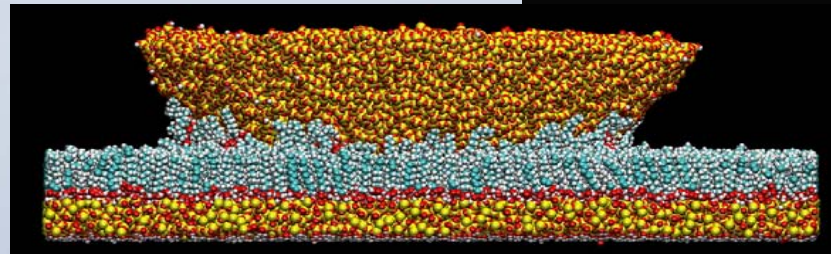
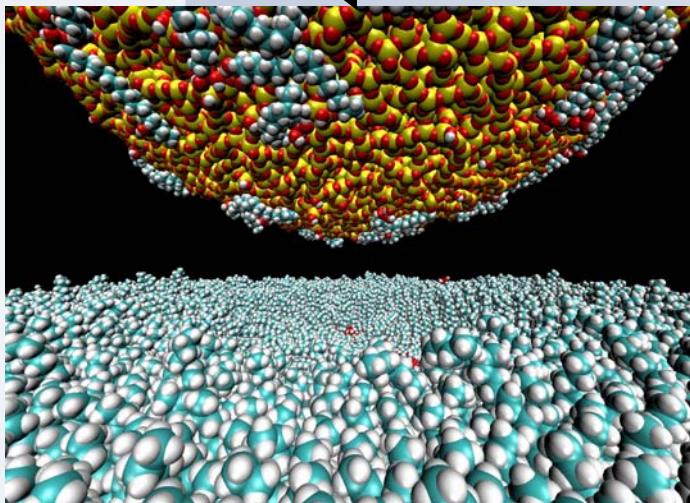
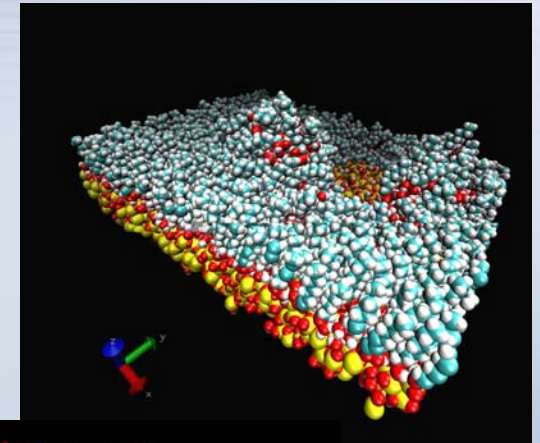
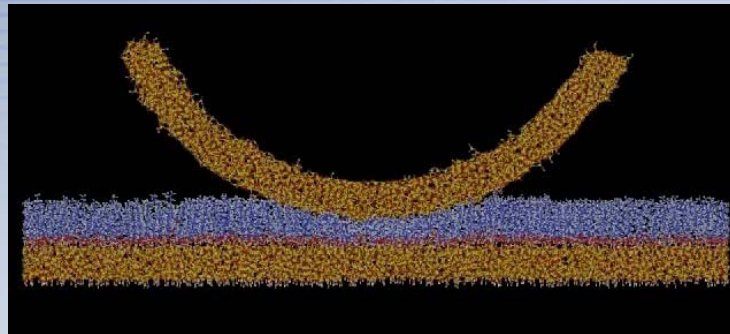
### Informatics

# Molecular Level Study of Microsystems Coating

Science based simulations provide more detailed results – not less – than experiments alone



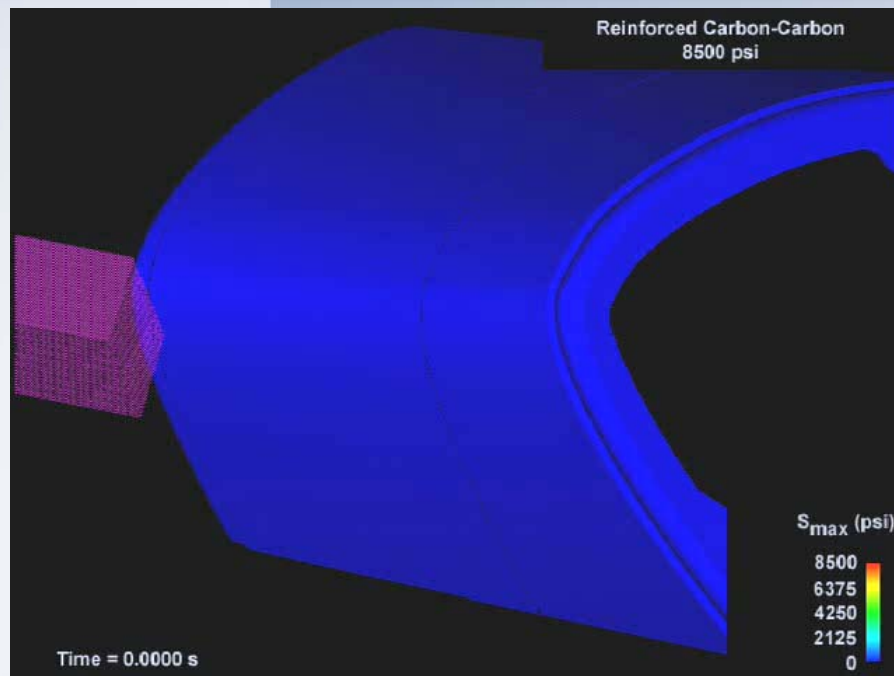
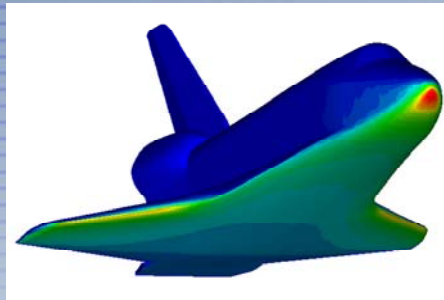
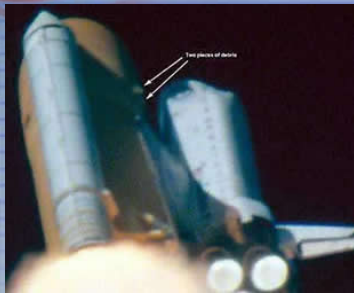
Probe Tip of Atomic Force Microscope



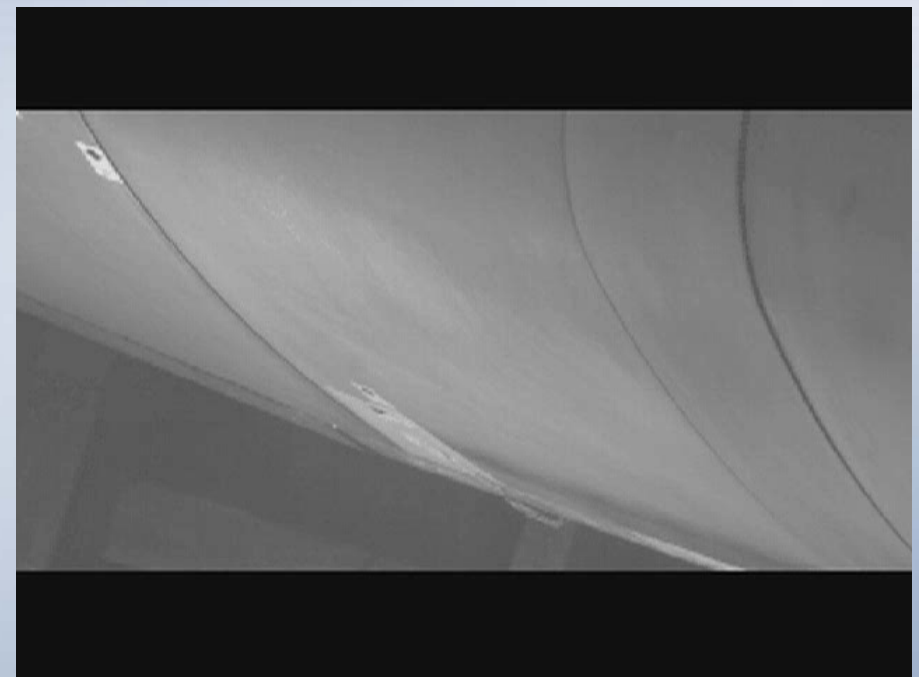
Polymer Coating on MEMS



# Study of the Columbia Accident



**Sandia Simulation**

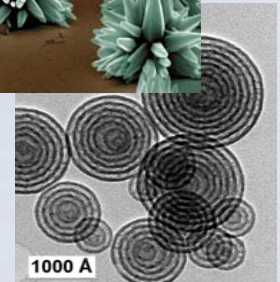
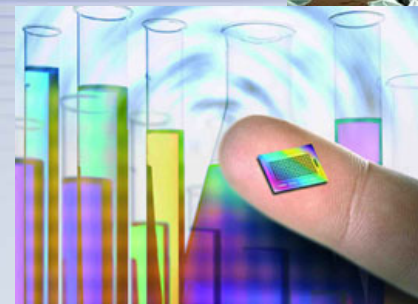
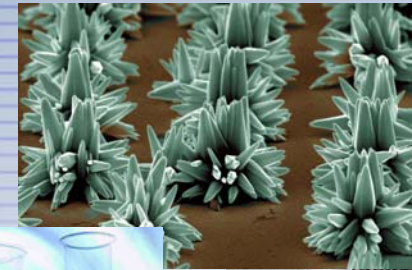


**Physical Test**

# Critical National Security Needs

## – *Creating Materials by Design* –

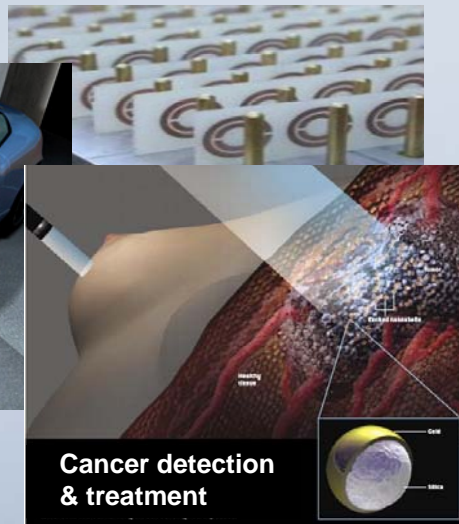
- Take advantage on new functions from complex & hierarchical micro/nano materials
  - Lab-on-a-chip based sensors
  - Energy
  - Bio-medicine
  - Intelligence



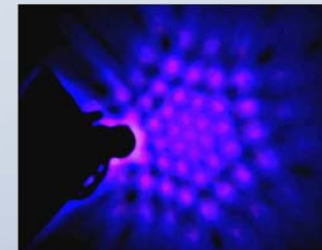
Metamaterials



Cloaking



Cancer detection  
& treatment



Photonic  
Lattice LED



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# Science & Technology Opportunities

- **Microsensors**
  - Wireless technology
  - Power harvesting / storage
  - New materials
- **Cyber security**
  - Network & infrastructure modeling
- **Petascale & exascale computing**
  - Power efficient hardware
  - Scalable software
- **From materials to integrated systems**
  - Design and functionalize
  - Processing, manipulation & integration

