SAND2011-3349P

May 10, 2011

Sandia National Laboratories

Leslie Phinney

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NNSA National Nuclear Security Administration

Sandia National Laboratories

Sandia's History

THE WHITE HOUSE
WASHINGTON

May 13, 1949

Dear Mr. Wilson:

I am informed that the Atomic Energy Commission intends to ask that the Bell Telephone Laboratories accept under contract the direction of [redacted] at Albuquerque, New Mexico. This operation, which is a [redacted] atomic [redacted] tional defense, and should have the [redacted] tional direction.

I hope that after you have heard more in detail from the Atomic Energy Commission, your organization will find it possible to [redacted] this task. In my opinion you have here an opportunity to render an **exceptional service in the national interest.**

I am writing a similar note direct to Mr. C. E. Buckley.

Very sincerely yours,

Harry Truman

Mr. Leroy A. Wilson,
President,
American Telephone and Telegraph Company,
195 Broadway,
New York 7, N. Y.

exceptional service in the national interest.

Sandia National Laboratories

Sandia's Sites

Albuquerque,
New Mexico

Livermore,
California

Tonopah, Nevada

Waste Isolation Pilot Plant,
Carlsbad, New Mexico

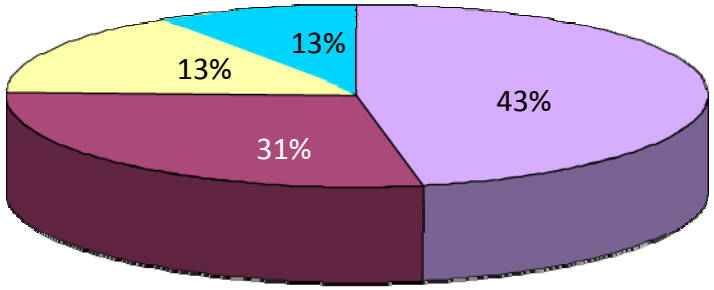
Pantex, Texas

Sandia National Laboratories

People and Budget (As of October 15, 2010)

- On-site workforce: 11,677
- Regular employees: 8,607
- Gross payroll: ~$898.7 million

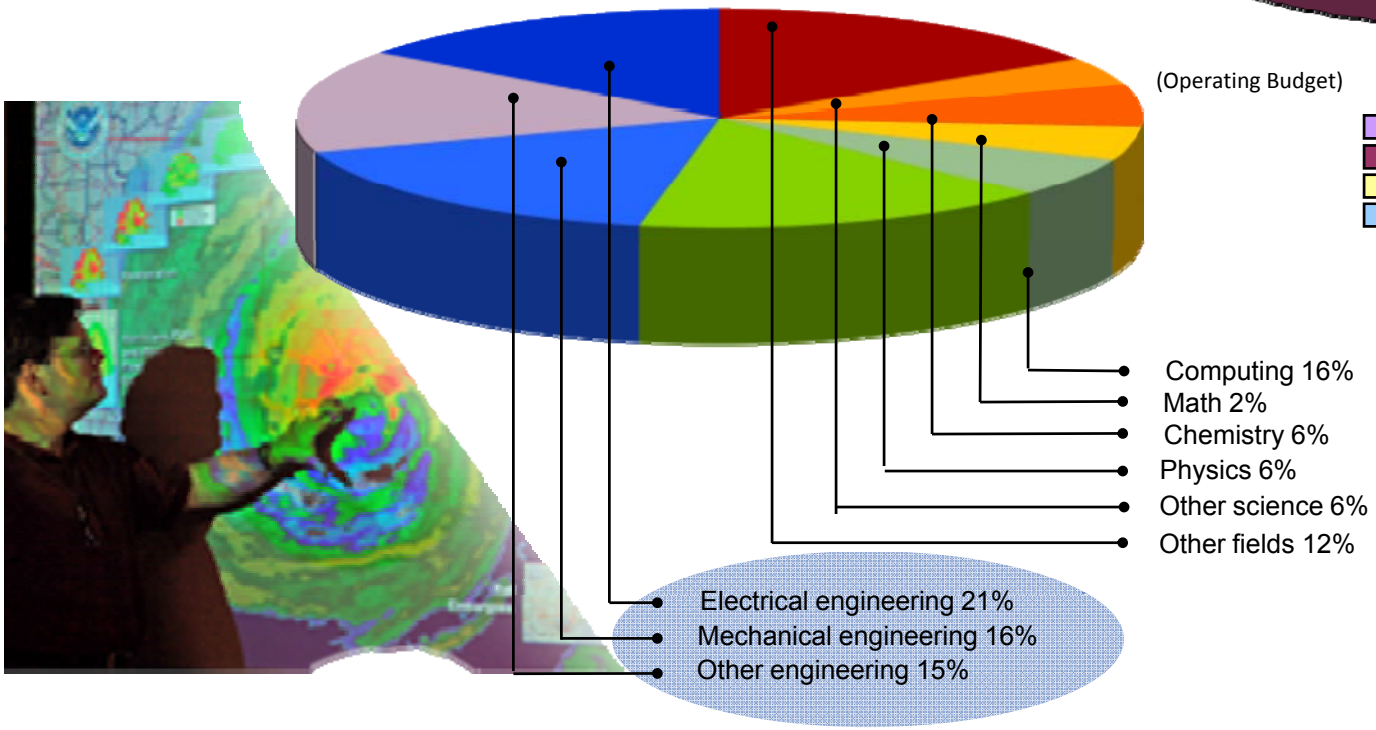
FY10 operating revenue
$2.3 billion



(Operating Budget)

- Nuclear Weapons
- Defense Systems & Assessments
- Energy, Climate, & Infrastructure Security
- International, Homeland, and Nuclear Security

Technical staff (4,277) by discipline:



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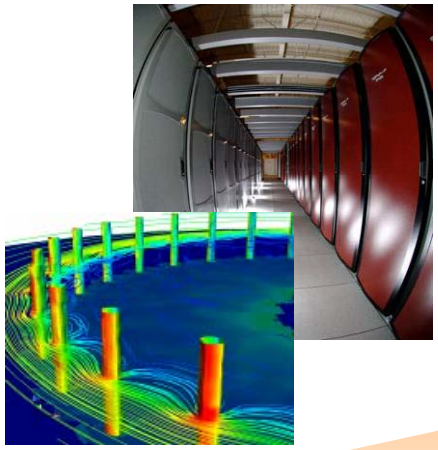
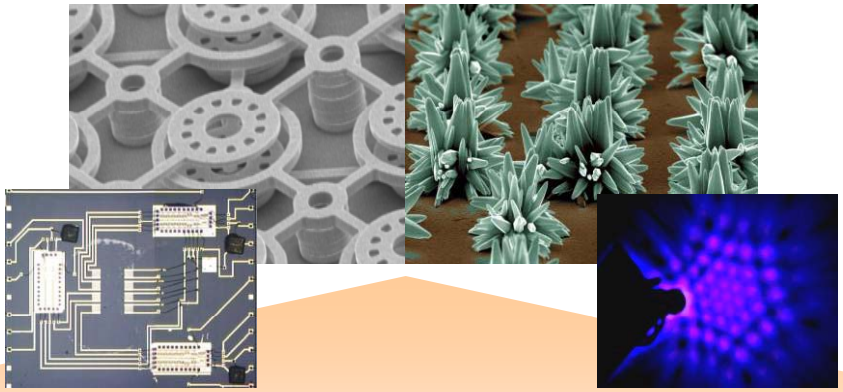
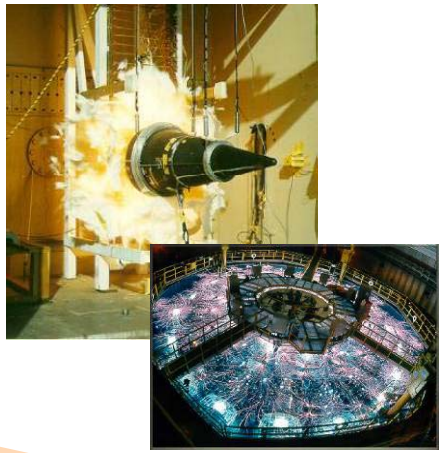
Research Disciplines Drive Capabilities





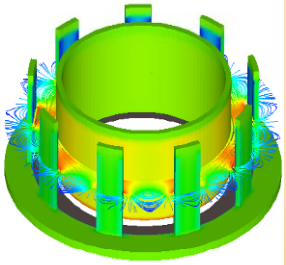


High Performance Computing

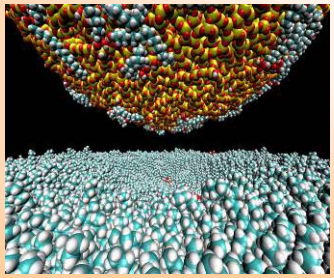
Nanotechnologies & Microsystems

Extreme Environments

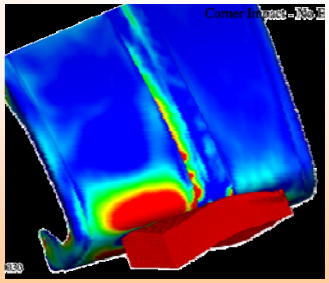
Computer Science



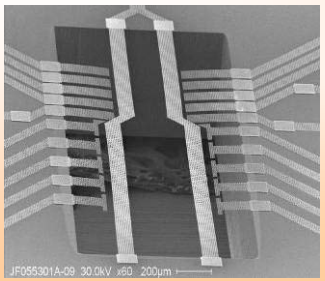
Materials



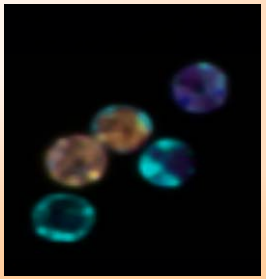
Engineering Sciences



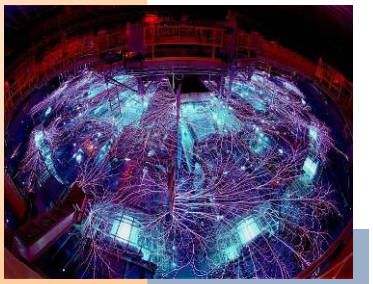
Micro Electronics



Bioscience



Pulsed Power



Research Disciplines

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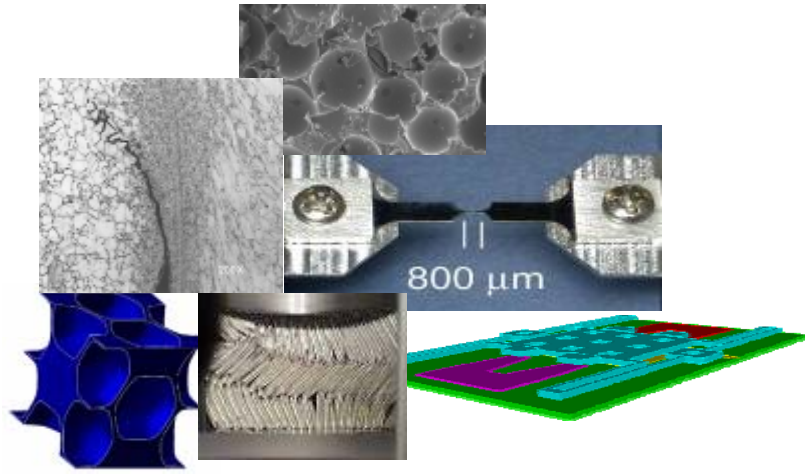
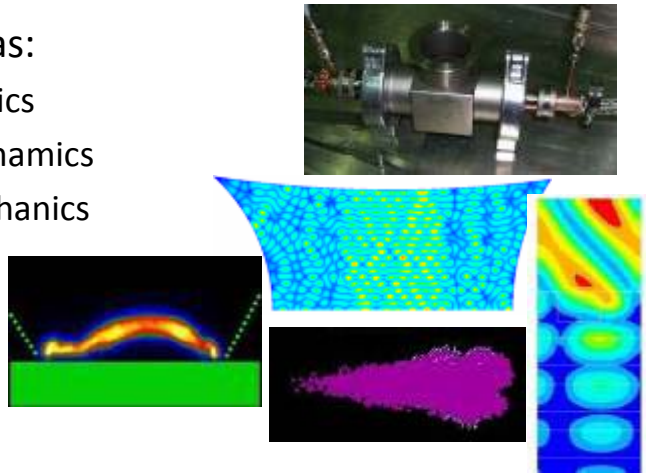
Engineering Sciences Center at Sandia National Laboratories



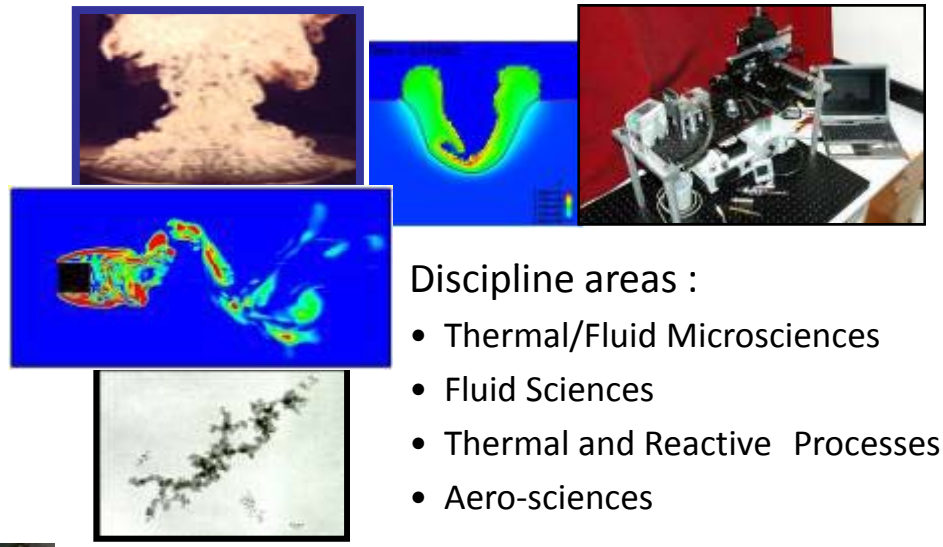
Solid/Material Mechanics & Structural Dynamics

Discipline areas:

- Solid Mechanics
- Structural Dynamics
- Material Mechanics



Thermal, Fluids & Aero-sciences



Discipline areas :

- Thermal/Fluid Microsciences
- Fluid Sciences
- Thermal and Reactive Processes
- Aero-sciences

Electrical Sciences

Discipline areas:

- Electromagnetics and Plasma Physics
- Electrical Processes

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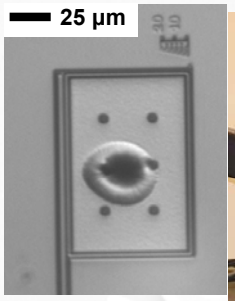
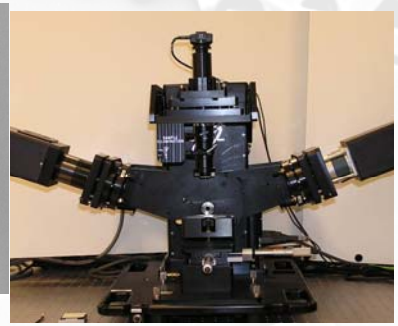
Micro-Thermal Diagnostic Capabilities

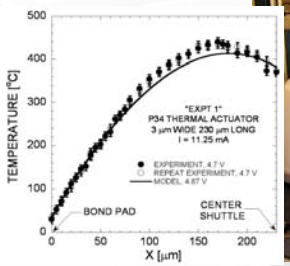
Measurement of optical-thermal phenomena in microsystems
- Temperature-dependant optical properties
- Laser-induced thermal damage in microsystems

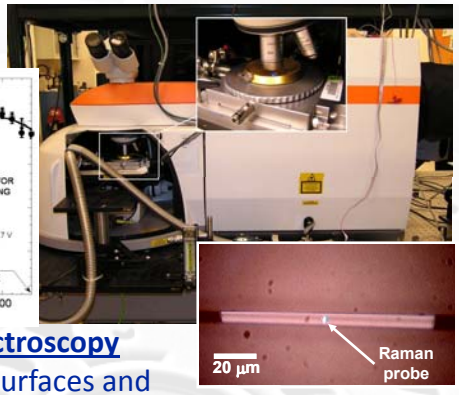


Laser damaged microactuator

Variable angle ellipsometer

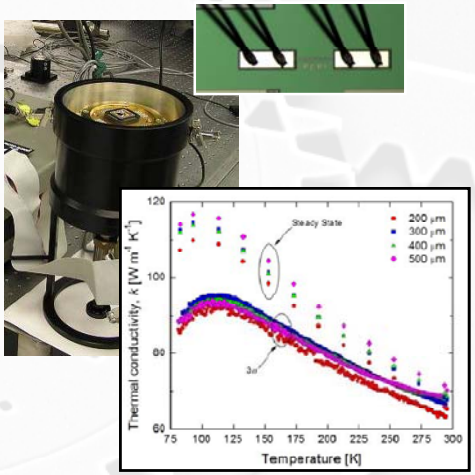






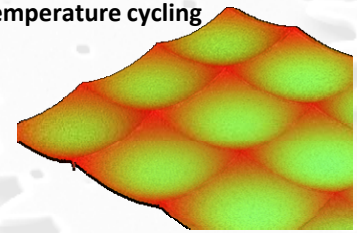
microRaman Spectroscopy
Thermometry of surfaces and microsystems

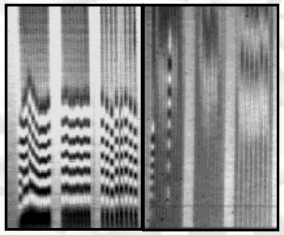
Thermal conductivity measurements for thin films
- Steady-state & 3ω techniques
- Transient thermoreflectance



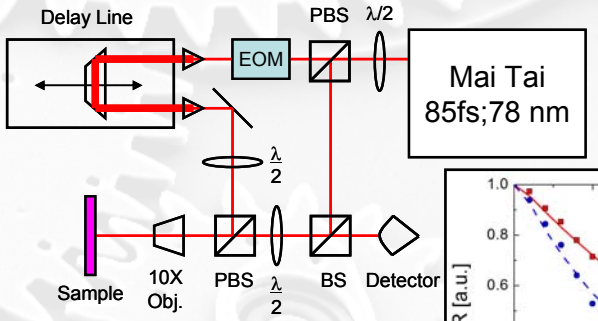
Interferometric imaging
Measurements of thermomechanical effects in microsystems

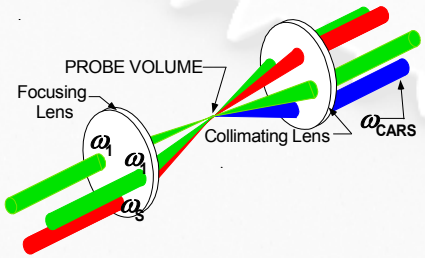
Deformed micromirrors after temperature cycling





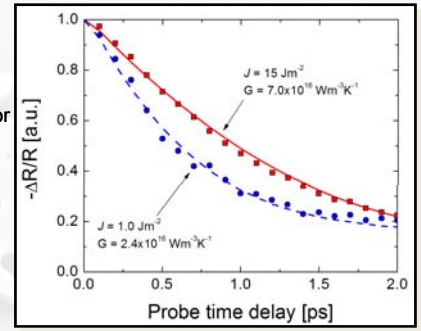
Laser repair of adhered microcantilevers





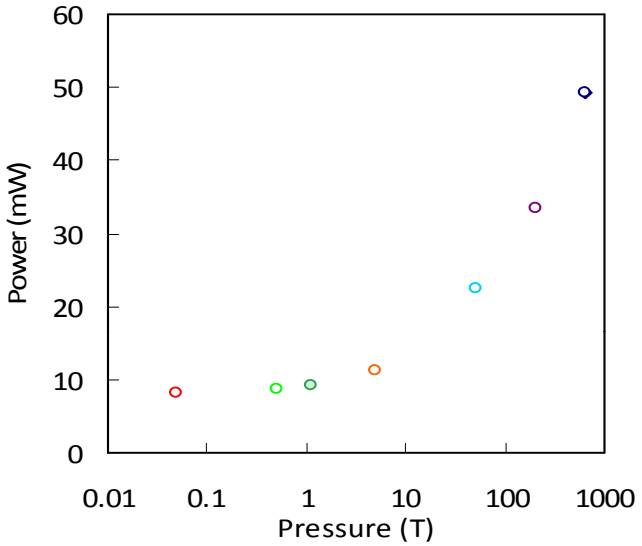
Coherent Anti-Stokes Raman Spectroscopy (CARS)
Thermometry in rarefied gas environments

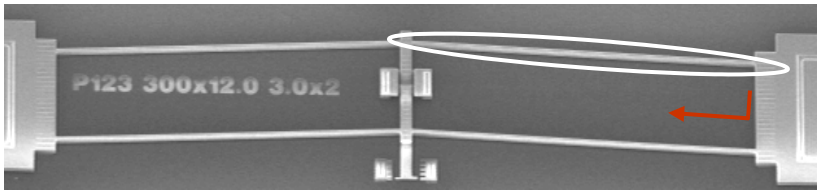
Femtosecond laser diagnostics for Measurements of thermal conductivity, thermal conductance at interfaces, and electron-phonon coupling factors (G) in interfacial thermal transport in thin films

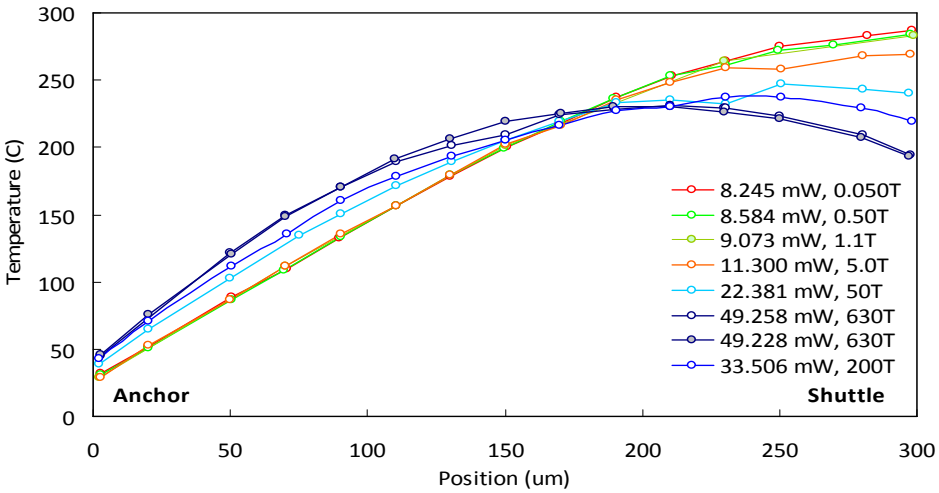


TTR of 20nm Au on glass

Environmental Effects: Thermal Microactuators Operated in Varying Pressures







- Temperature measured along length of actuator leg at regular intervals
- Pressure of nitrogen environment varied from 0.05 torr up to ambient pressure (625 torr)
- Device powered with constant current source
- Impact of thermal transport by surrounding gas is noticeable on temperature profile
- Impact of central shuttle on thermal profile minimal at lower pressures
- Uncertainty: ±6.1°C

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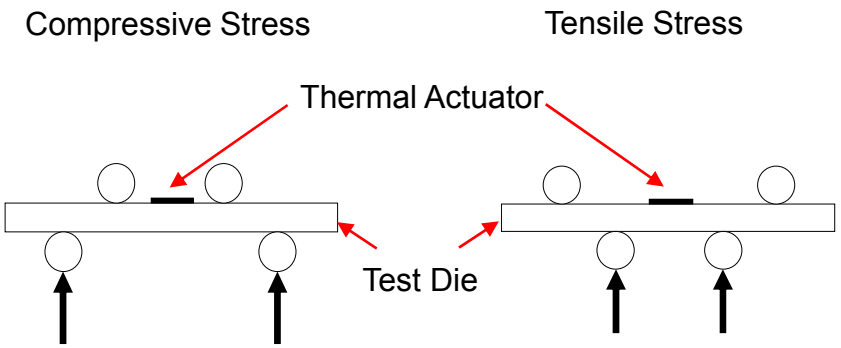
Environmental Effects: Thermal Microactuators Subject to Mechanical Stress



Four Point Bending Stage

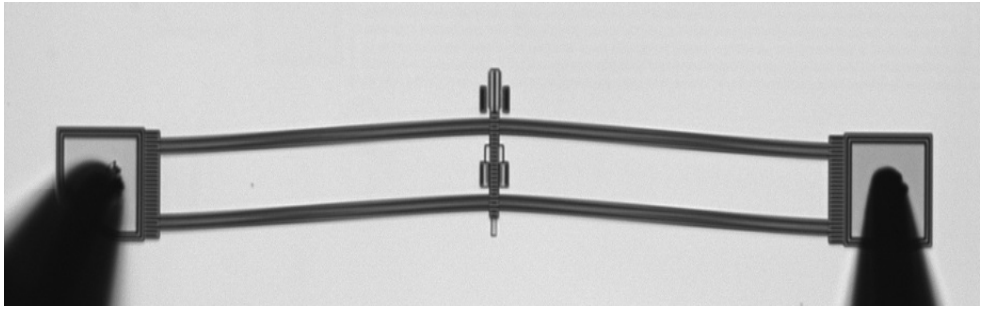
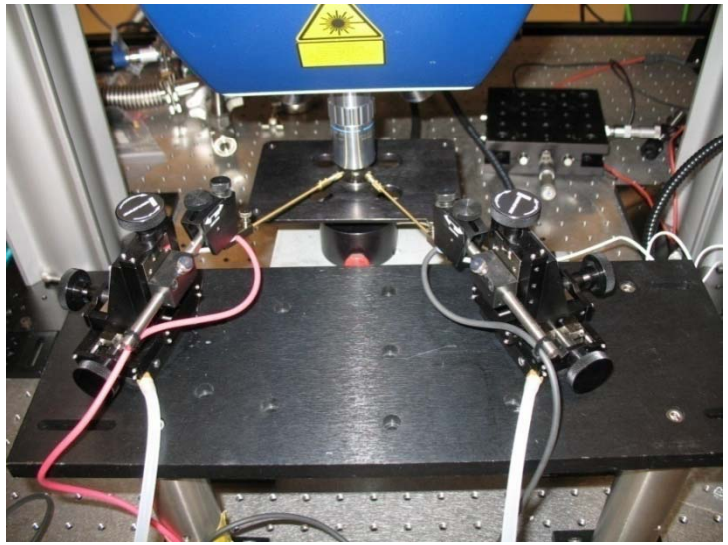
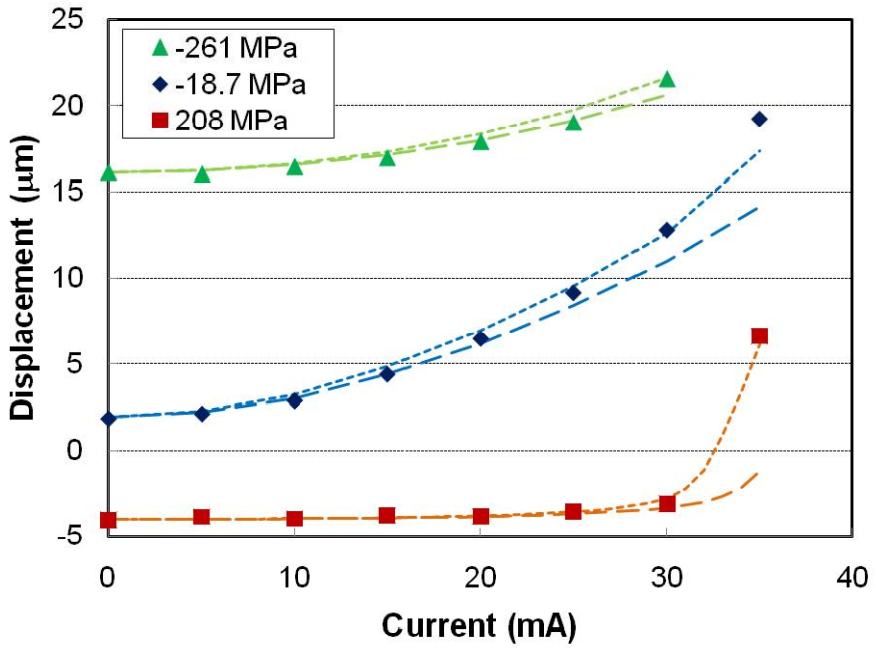


Image of Powered Microthermal Actuator with Probe Tips

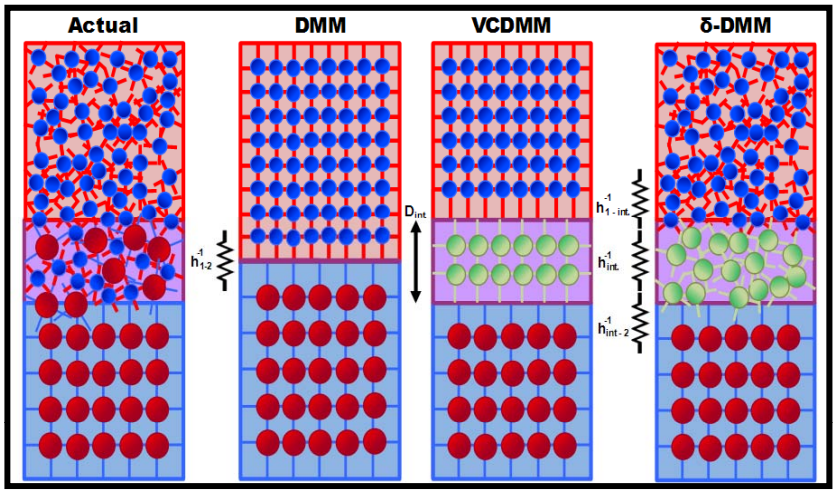


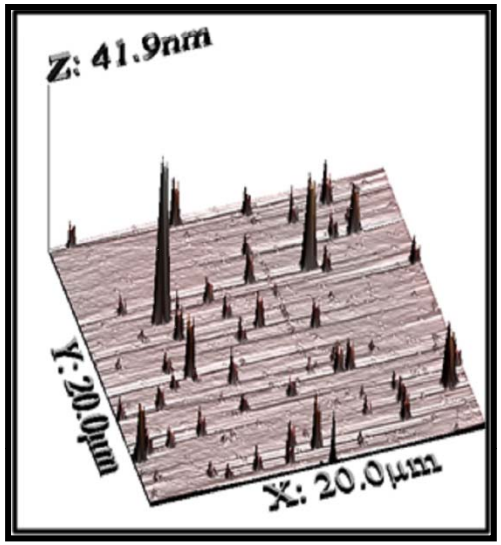
Bending Stage, Manipulators, Probe Tip Holders, Microscope

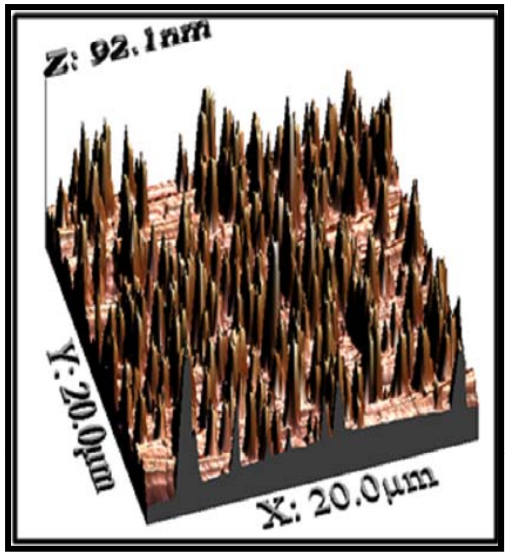


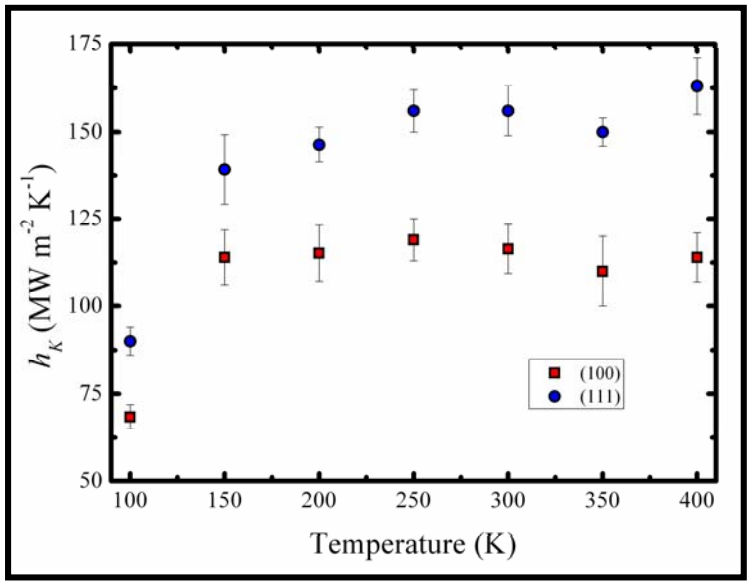
Phinney, Spletzer, Baker, and Serrano, 2010, *Journal of Micromechanics and Microengineering*, **20**, Article No. 095011.

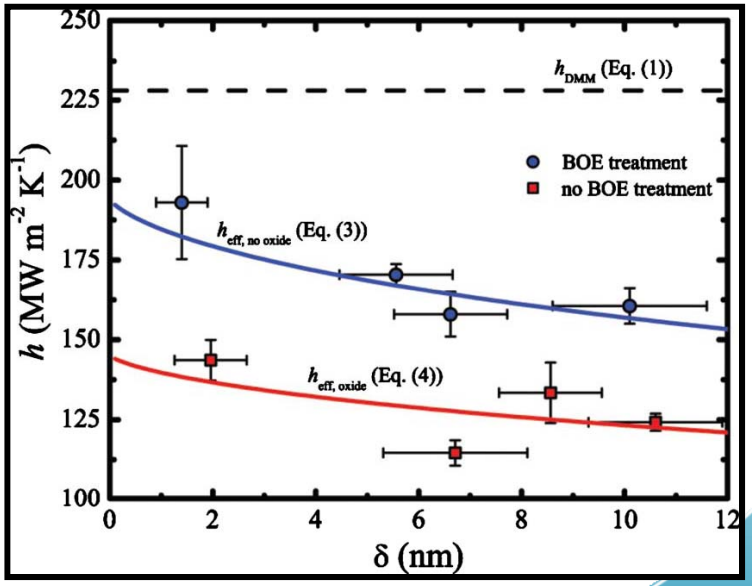
Interfacial Properties on Thermal Resistance











Hopkins, Phinney, Serrano, and Beechem, 2010, *Physical Review B*, **82**, Article No. 085307.

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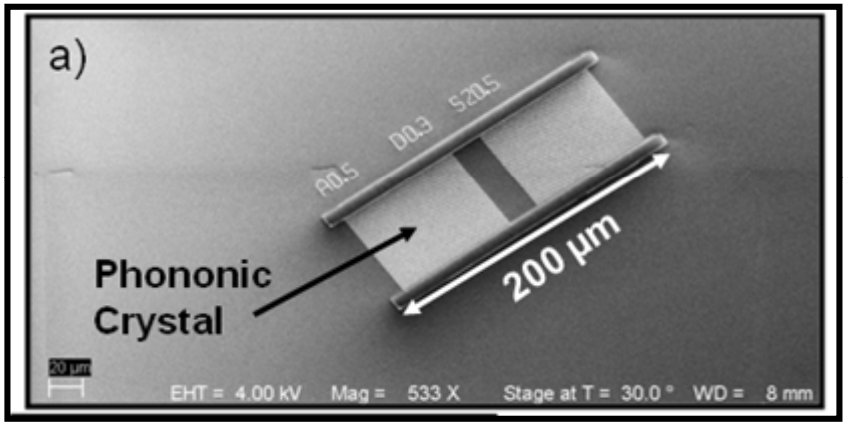
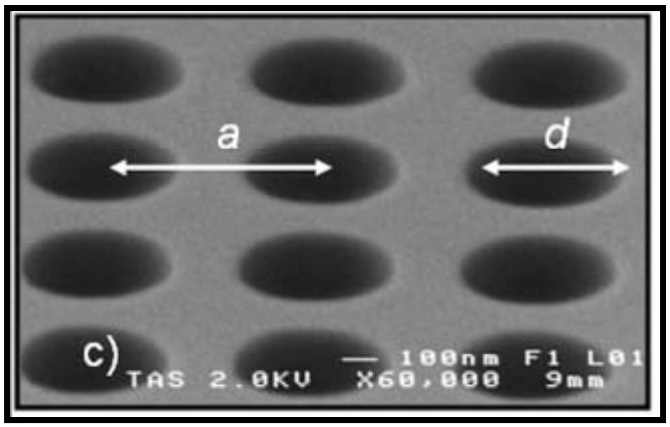
Thermal Transport in Phononic Crystals

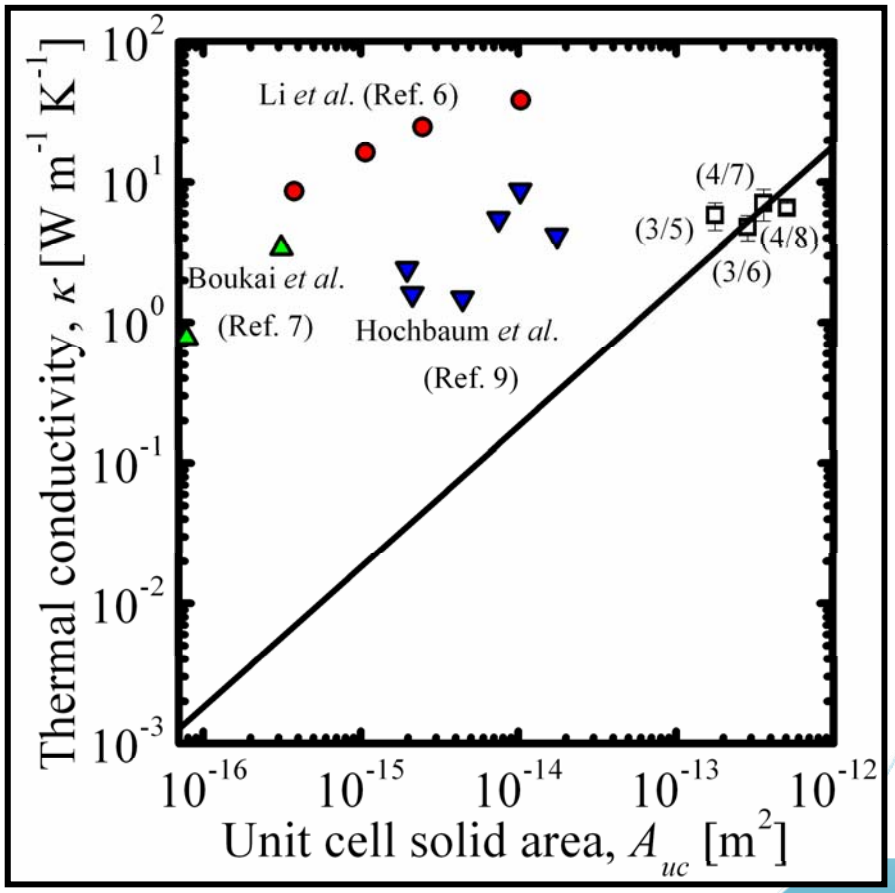
Phononic crystals

Can we control phonon modes on a larger scale to manipulate thermal conductivity at a more appropriate device level?





SNL PnC's have the lowest thermal conductivity to solid area ratio of any nanosystem to date!



Hopkins et al., 2011, *Nano Letters*, **11**, pp. 107-112. Hopkins et al., 2011, *Applied Physics A*, available online.

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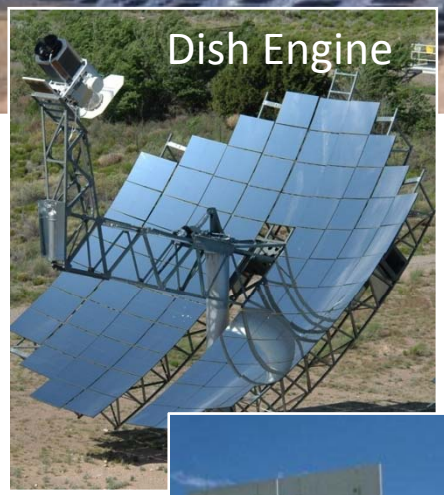
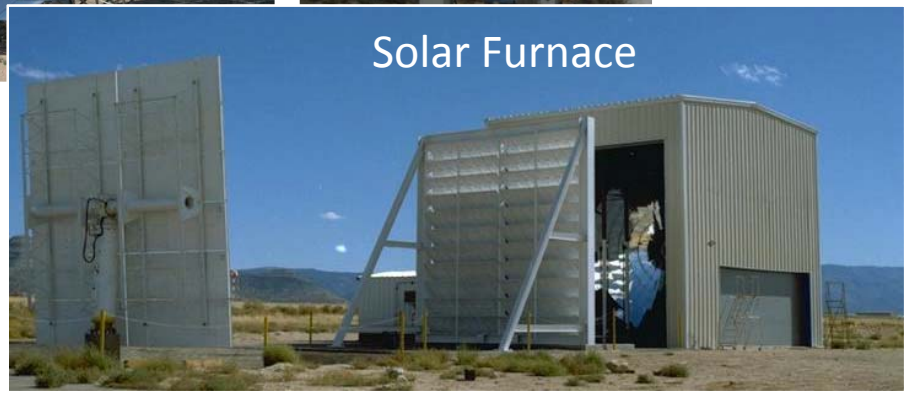
National Solar Thermal Test Facility

- High temperature studies
- Component testing
- Materials development



- Power production
- Efficiency improvements
- Industry support



- Storage integration
- Fuel production

Viewgraph courtesy of Brian Iverson.

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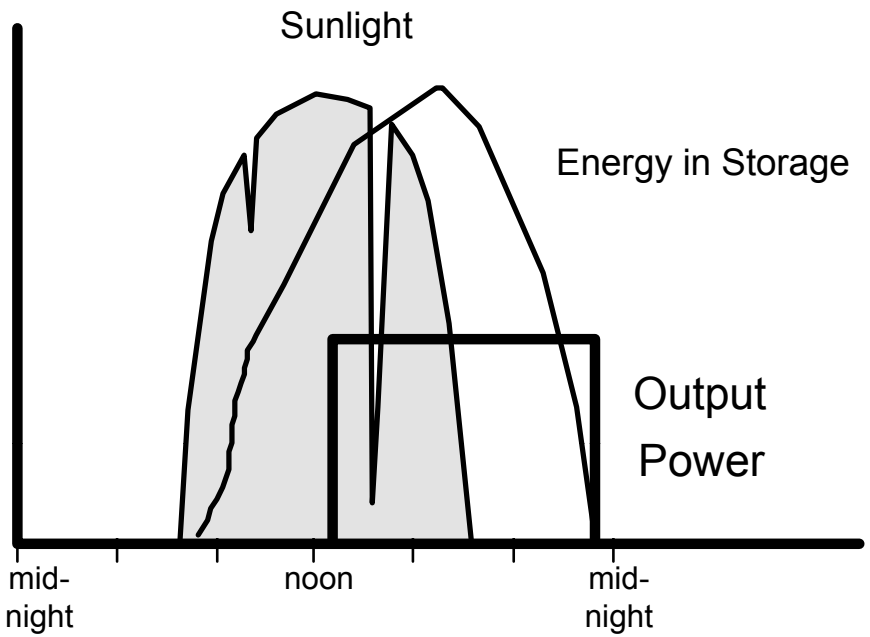
Thermal Storage

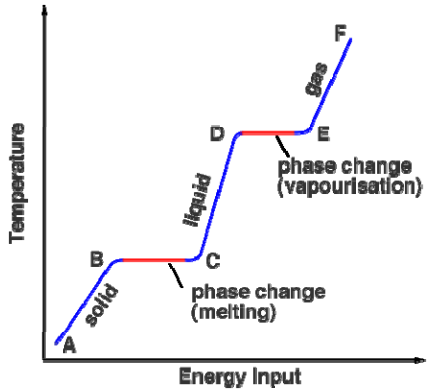


$$\text{Capacity Factor} = \frac{\text{Actual Output}}{\text{Full Nameplate Capacity}}$$

Energy Source	Capacity Factor
Wind	20-40%
PV (flat plate)	20-25%
CSP (with storage)	40-70%
Nuclear	80-100%
Coal	70-90%
Natural gas (combined cycle)	~60%

Solutions:

Sensible
and/or
Latent



Thermochemical (eg. water splitting)

1) Fe_3O_4 + Heat→ 3FeO + 1/2O_2

2) 3FeO + H_2O → Fe_3O_4 + H_2

Net: H_2O → H_2 + 1/2O_2

Viewgraph courtesy of Brian Iverson.