

# Nano Infrastructure Research Group- University of Mississippi

## Introduction

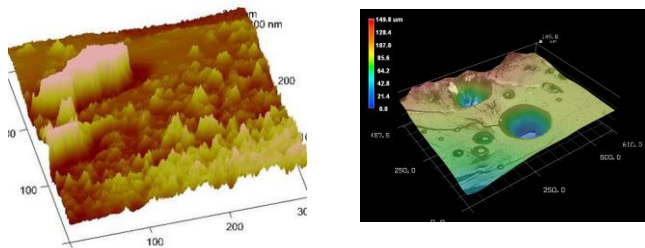
The Nano Infrastructure Research Group (NIRG) focuses on the utilization of nano particles such as carbon nanotube, nanowire, nanoclay, graphite and glass platelets, and flyash, for reinforcing polymers and concrete to make *nanocomposites*. These composites are applied to the protection of infrastructures (buildings, bridges, tunnels, pipelines, ports, levees and floodwalls, power and communication transmission facilities) against all kinds of natural hazards and terrorist threats, including blast, impact, earthquakes, hurricanes, fire, corrosion, and fatigue collapse. These materials are also used in defense applications such as protecting navy ships against blast, for fire protection, and shielding against electromagnetic detection (stealth).

Strengths include:

- blast survivability and homeland security;
- composite/hybrid materials and structures;
- mechanics from nano and micro, on up to macro scales;
- impact and crash worthiness;
- electric power and telecommunications;
- chemical and biological systems; and
- simulations/modeling.



Thermal Analysis



Atomic Force Microscopy

3D Imaging

## Funding and Research Partners

NIRG was founded in 2006 and has established collaborative research projects with several state and federal agencies, academic partners and industrial partners.

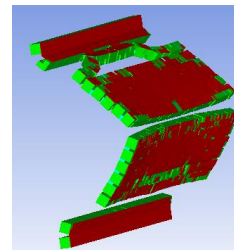


Shock Tube

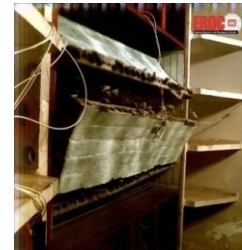
## Research Interest Areas

The primary research interests of scientists with NIRG include:

- Impact, blast, and crash; vibration and dynamic mechanical analysis
- Hybrid and cement/polymer based composites for low-cost and high-durability infrastructure applications
- Mechanics of damage under multiple spatial/time scales; long-term performance, durability, aging, and environmental effects of materials; mechanics of porous materials
- Nano mechanics and nano composites: nano, micro, meso and macro scales
- Advanced computational simulations and modeling of structures, components, and systems
- Nano coatings and bio-sensors
- Non-destructive testing (NDT) and Resonant Ultrasound Spectroscopy (RUS)
- Structural health monitoring, repair, and rehabilitation
- Electromagnetic Interference (EMI) and radar shielding
- Nanoengineering Bioinformatics



FEA Analysis



Experiment

Blast Loading

For more information contact:



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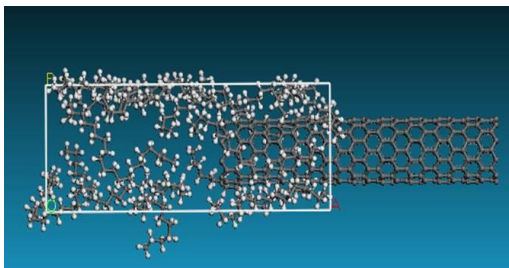
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# Nano Infrastructure Research Group- University of Mississippi

## R&D Focus and Partnership Opportunities

NIRG is seeking development partners to utilize nanoparticle enhanced and other advanced composites for various engineering applications to explore and stimulate research into various nano engineering applications, such as:

- infrastructure
- electronics
- biomaterials
- geomaterials
- chemical and biological sensors
- automobile industry
- aerospace
- manufacturing
- pharmaceuticals



**Molecular Dynamics Simulation**

## Development Capabilities

The researchers at NIRG have the knowledge, skills, and ability to readily design and develop nanoparticle enhanced and other advanced nano composites for civil infrastructure, survivability and homeland security applications such as designing the next generation of sustainable, environmentally friendly, and energy efficient structures.

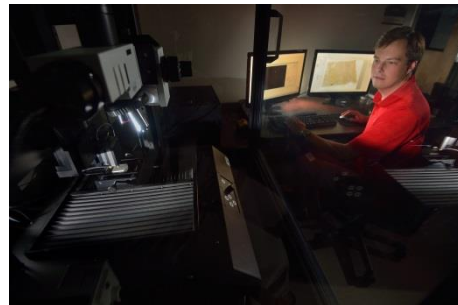
## Facilities and Resources

Researchers at the NIRG have access to resources which include software, hardware, and data needed to conduct nano and composite structures research:

### Testing Facilities

- Thermal Analysis
  - TA Instruments Model Q800 Dynamic Mechanical Analyzer (DMA)
  - TA Instruments Model Q500 Thermogravimetric Analysis (TGA)
- Blast and Dynamic evaluation
  - HP modal and spectrum analysis equipment for dynamic property evaluation
  - Split-Hopkinson Pressure Bar (SHPB)
  - Shock Tube/ blast load simulator

- Dynatup 8250 HV instrumented impact test system with temperature chamber
- Nano Imaging
  - Keyence Digital Microscope VHX-600E
  - Digital Instruments Nanoscope IIIa Multimode Scanning Probe Atomic Force Microscope
  - Nanovea Nano Mechanical Tester
- Mechanical Testing
  - 22 kip MTS with hydraulic wedge, environmental chamber & accessories
  - Enduratec Axial/Torsion Smart Test System
  - HCM-2500 Series 250,000 lbf compression tester
  - Transmission and reflective photoelastic experimental stress analysis
- Durability and Aging
  - Tenney Environmental Chamber
  - Rapid Freeze-Thaw Cabinet
  - Gamry Electrochemical Impedance Spectroscopy (EIS) equipment



**Nano Indentation**

### Computational Facilities

- Mississippi Center for Supercomputing Research (MCSR)
  - 224 CPU SGI Altix 3700 Supercomputer
  - 253 node Intel Linux Cluster
- Nano Infrastructure Laboratory
  - Origin 399 SGI Server
  - 5 O2 SGI Workstations
  - 2 Dual-Core Dell Workstations
- Software
  - FEA: ABAQUS, ANSYS/LS-DYNA, AUTODYN, SAP2000
  - DEM, Molecular Dynamics, Particle Dynamics
  - Modal Analysis

NIRG also has access to ERDC labs in Vicksburg, MS and to facilities within the School of Engineering which include the Composite Materials Manufacturing and Mechanical Testing facilities.

For more information contact:



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