

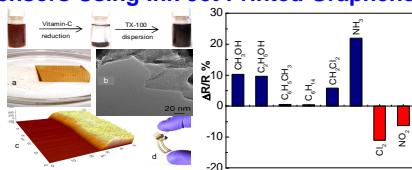
## Research in Frontier Materials

Our research is in the synthesis and characterization of materials exhibiting novel and unexpected properties with application in nanotechnology, biotechnology, and sustainable engineering and chemistry. Lines of inquiry include:

1. Sensors for detecting chemical warfare agents using soft nanotechnology (carbon nanotubes, graphene and conducting polymers).
2. Synthesis and characterization of nanostructured materials using green chemistry approaches.
3. Sensors for detecting endotoxins and biological threat agents.
4. Conversion of waste cellulose to biodegradable plastics.

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## Sensors Using Ink-Jet Printed Graphene

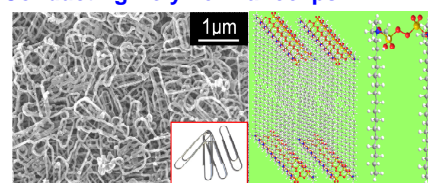


Developed a new green chemistry method to synthesize graphene, including the construction of a flexible, chemical warfare agent detector.

### Research Outputs:

1. Publication: **Angewandte Chemie** 49 2154 (2010).
2. Patent: Provisional application filed (2010).
3. Collaboration: Prof. Rodney Ruoff, Univ Texas Austin

## Conducting Polymer Nanoclips

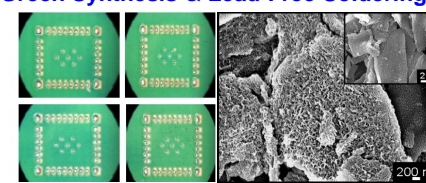


New method to synthesize conducting polymers in the form of nanosized clips using a very simple, water-based oxidative approach.

### Research Outputs:

1. Publication: **Journal of the American Chemical Society** 132, 13158 (2010).
2. Collaboration: Prof. Xinyu Zhang, Auburn University.

## Green Synthesis & Lead-Free Soldering

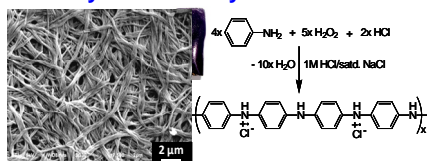


Developed a new green chemistry method to synthesize a nanostructured conducting polymer surface finish for lead free electronics.

### Research Outputs:

1. Publication: **Green Chemistry** 12 585 (2010).
2. Collaboration: Benchmark Electronics, TURI.
3. Award: TURI, and citations from MA State House

## Green Synthesis of Synthetic Metals

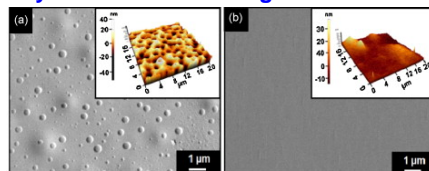


Developed a new green chemistry method to synthesize nanostructured conducting polymers using hydrogen peroxide (no toxic byproducts).

### Research Output:

1. Publication: **Journal of the American Chemical Society** 131 12528 (2009).

## Polyaniline: A Warfare Agent Sensor

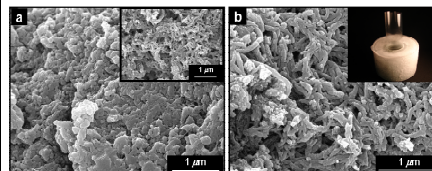


Described a new method to detect highly oxidizing and toxic vapors like nitrogen dioxide using a conducting polymer film (chemiresistor).

### Research Output:

1. Publication: **Sensors and Actuators B** 143 454 (2009).

## Nanofiber Growth Puzzle Solved

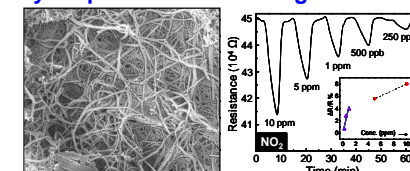


Uncovered evidence for a new mechanism for nanofiber formation in conducting polymers. Solves a 10 year old puzzle in polymer chemistry.

### Research Output:

1. Publication: **Macromolecules** 42 1792 (2009).

## Polythiophene: A Warfare Agent Sensor

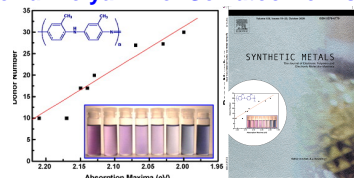


Described a new method to detect chemical warfare agent vapors using thin films of the conducting polymer polythiophene as the main sensing element.

### Research Output:

1. Publication: **Macromolecules** 42 5414 (2009).

## Colorful Polyaniline: Solvatochromism

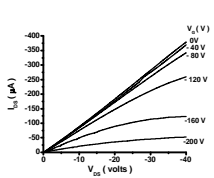


Described the origins of an unusual phenomenon in polyaniline, i.e., polymers display different colors in different solvents.

### Research Outputs:

1. Publication: **Synthetic Metals** 159 2153 (2009).
2. Cover: Work featured on the cover of journal.

## Flexible Plastic Transistors

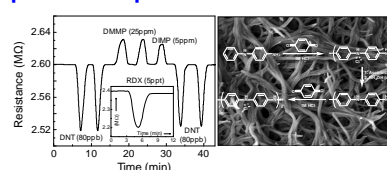


Fabricated a flexible, all-organic transistor device made using the conducting polymer polyaniline.

### Research Outputs:

1. Publication: **Journal of Applied Physics** 103 194501 (2008).

## Explosives Vapor Sensors

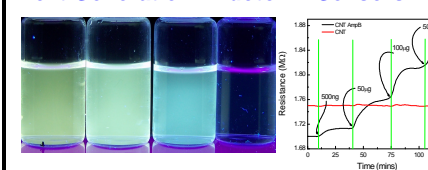


Uncovered a new chemiresistor material based on conducting polymers and carbon nanotubes that can detect explosives in air.

### Research Output:

1. Invention Disclosures: Six disclosures filed in 2010.

## Next Generation Endotoxin Sensors



Developed a new method to detect endotoxins in the bloodstream using functionalized carbon nanotubes, and conducting polymers.

### Research Output:

1. Invention Disclosures: Two disclosures filed in 2010.