THE UNIVERSITY OF ALABAMA IN HUNTSVILLE
COLLEGE OF ENGINEERING

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Fabrication and Characterization of PDMS Based Materials for Stretchable and Flexible Electronics

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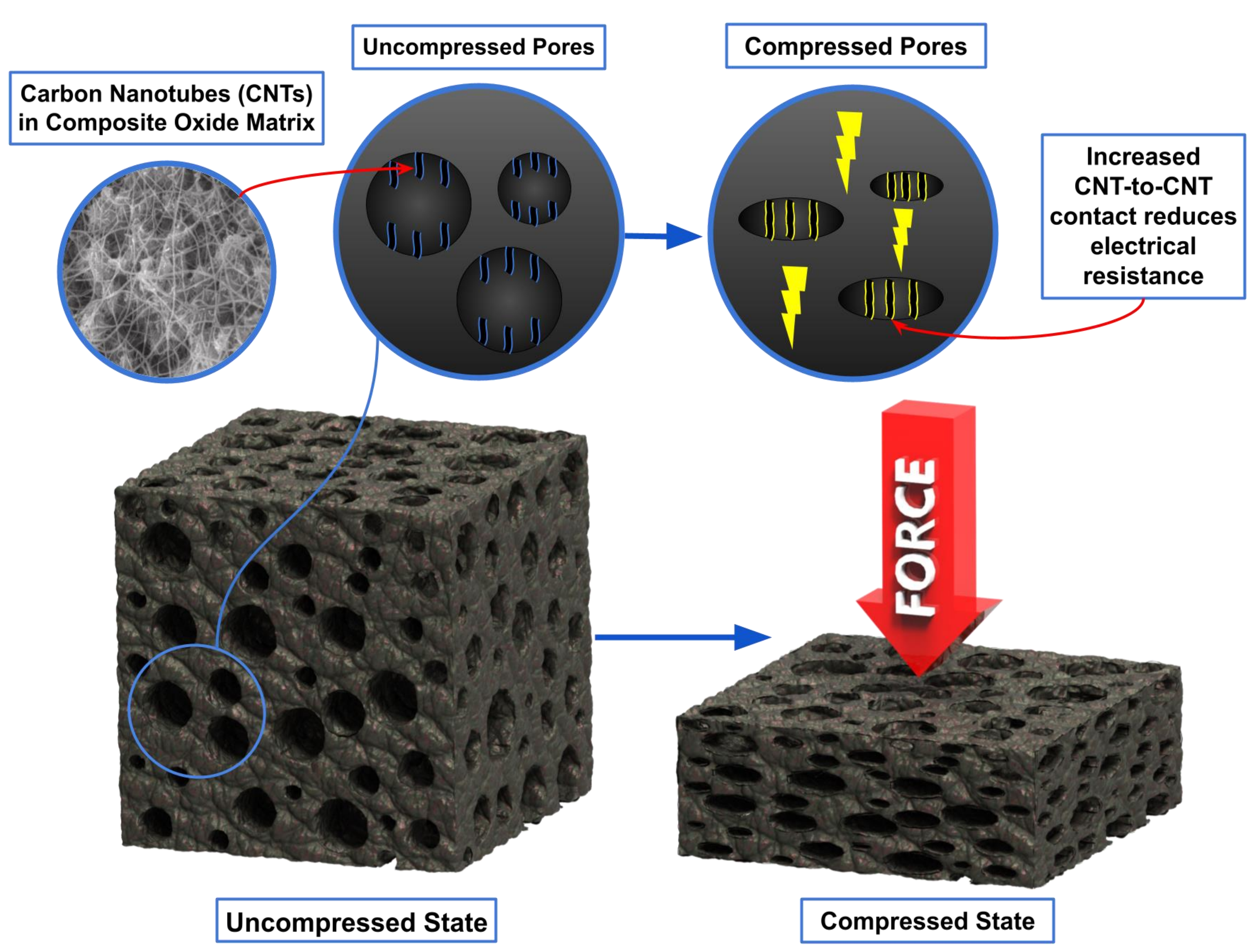
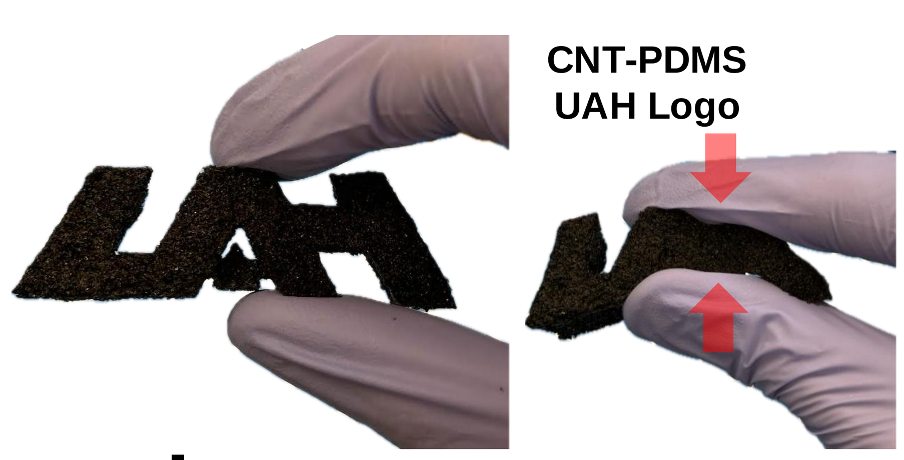
Overview

- ❑Flexible electronics are an emerging field that focuses on developing electronic devices that can bend and conform to various surfaces. These devices have diverse applications, including consumer electronics, biomedical devices, and wearable technology, due to their adaptability, durability, and biocompatibility.
- ❑This research focuses on creating porous, electrically conductive CNT-PDMS materials suitable for piezoresistive wearable electronics, with varied porosities achieved using sugar granules as a sacrificial template.

Conductive Porous PDMS Concept

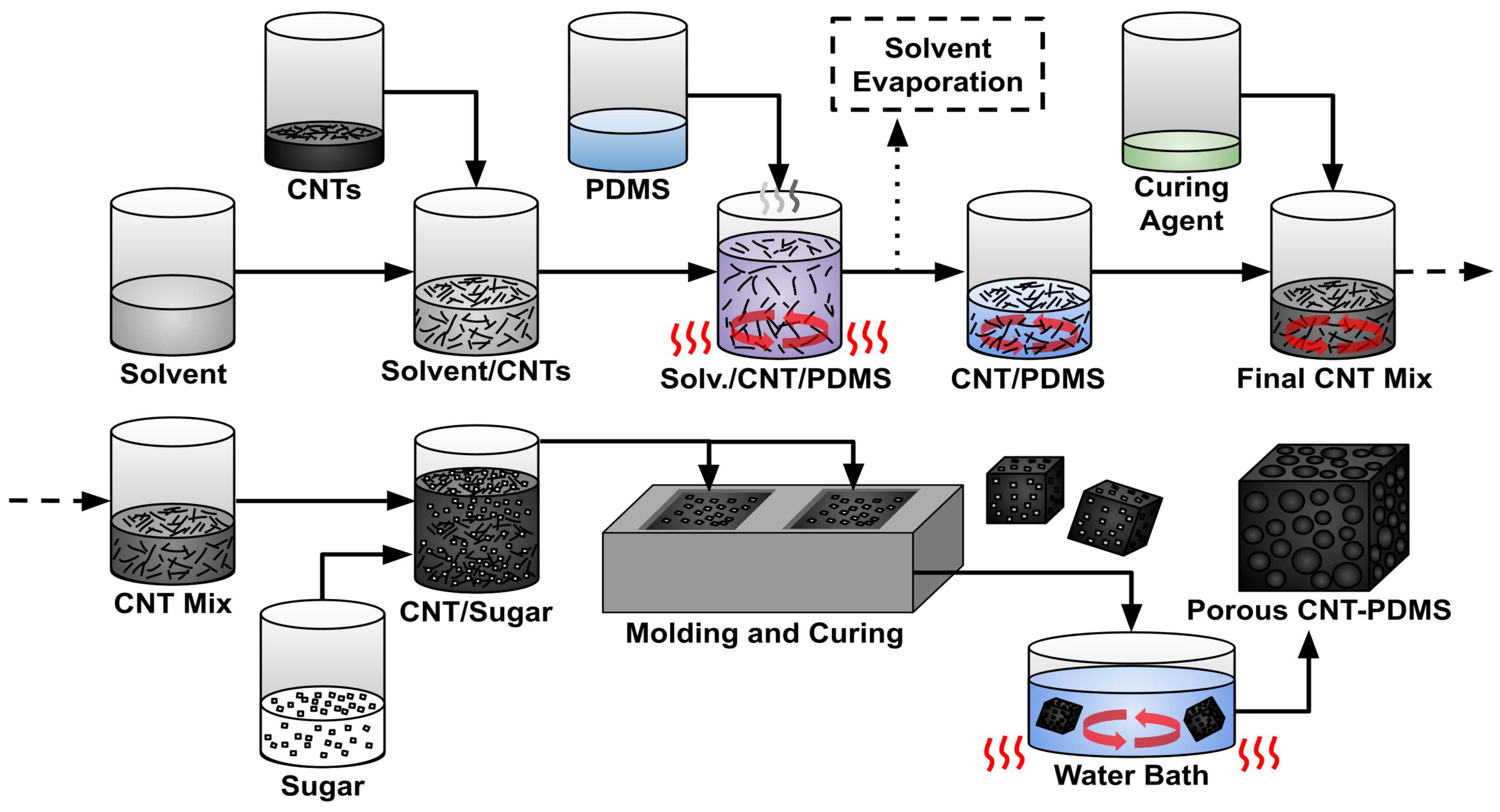


Porous PDMS Without CNTs



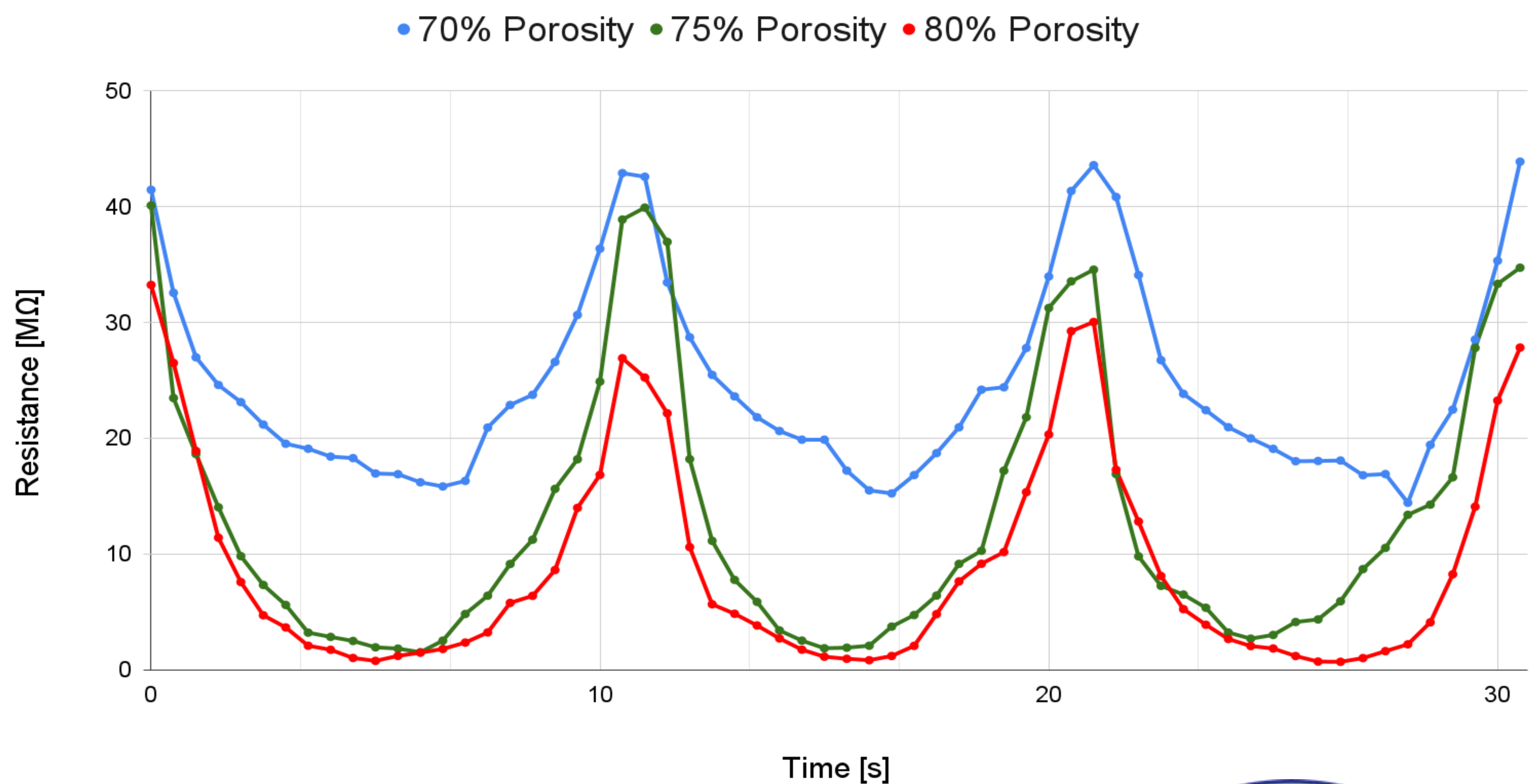
CNT-PDMS UAH Logo

Porous CNT-PDMS Fabrication Process



- ❑ **PDMS (Polydimethylsiloxane)**: A flexible, biocompatible elastomer used in a variety of applications, particularly in flexible electronics due to its stretchability and ease of fabrication.
- ❑**Carbon Nanotubes (CNTs)**: Nanomaterials known for their exceptional electrical conductivity and mechanical strength, used to enhance the conductive properties of PDMS.
  - **Dispersion of CNTs in a Solvent:** Carbon nanotubes are first dispersed in a suitable solvent, This step ensures that the CNTs are well-separated and uniformly distributed.
  - **Combining PDMS and CNTs**: Mixing carbon nanotubes into liquid PDMS to create a composite material that maintains flexibility while becoming electrically conductive.
- ❑**Use of Sugar as a Sacrificial Material**: Sugar is added to the CNT-PDMS mixture and, after curing, it is dissolved to leave behind a porous, sponge-like structure in the PDMS.
  - **Controlling Porosity Levels:** The level of porosity (70%, 75%, 80%) in the final PDMS sponge is controlled by adjusting the amount of sugar added to the mixture.

Electrical Resistance of CNT-PDMS Under Compression with Varied Porosity



Results

- ❑ Successfully developed a fabrication process for a porous CNT-PDMS composite suitable for piezoresistive testing, demonstrating the material's potential for flexible electronics applications.
- ❑ Gained significant knowledge about solvents for dispersing CNTs, experimenting with acetone, isopropyl alcohol (IPA), tetrahydrofuran (THF), and chloroform. Ultimately, THF was chosen as the optimal solvent for this project due to its balance between safety and dispersion quality.
- ❑ Conducted compression testing on the porous PDMS, measuring electrical resistance across different porosity levels. The results indicated that higher porosity levels led to increased sensitivity, highlighting the material's tunable properties for specific applications.

References

1. **PDMS Sponges with Embedded Carbon Nanotubes as Piezoresistive Sensors for Human Motion Detection.** Herren, B.; Webster, V.; Davidson, E.; Saha, M.C.; Altan, M.C.; Liu, Y. Nanomaterials 2021, 11, 1740.
2. **Evaluation of porous polydimethylsiloxane/carbon nanotubes (PDMS/CNTs) nanocomposites as piezoresistive sensor materials.** Michel, T.R., Capasso, M.J., Cavusoglu, M.E. *et al. Microsyst Technol* **26**, 1101–1112 (2020).

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