

Development and Applications of Carbon Nanotube Textiles

Korea-US Forum on Nanotechnology

September 30th 2014

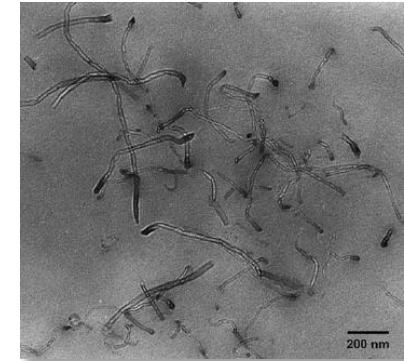
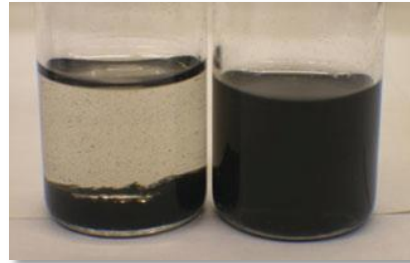
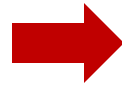
Dr. Philip Bradford, Assistant Professor
Department of Textile Engineering Chemistry and Science
NC State University



How are CNTs Usually Processed?

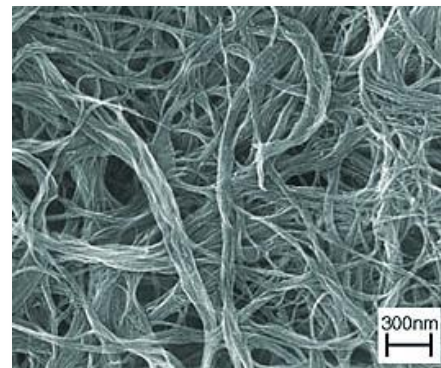
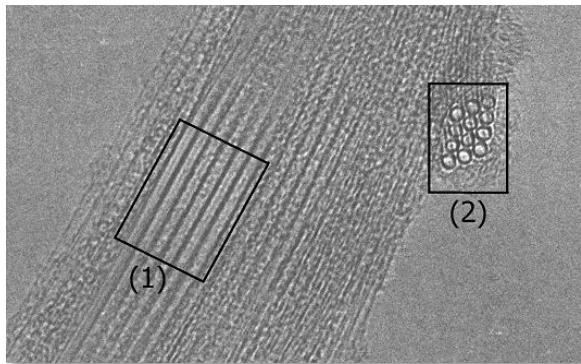


CNT Powder



Gojny et al., Compos. Sci. Tech. 2005

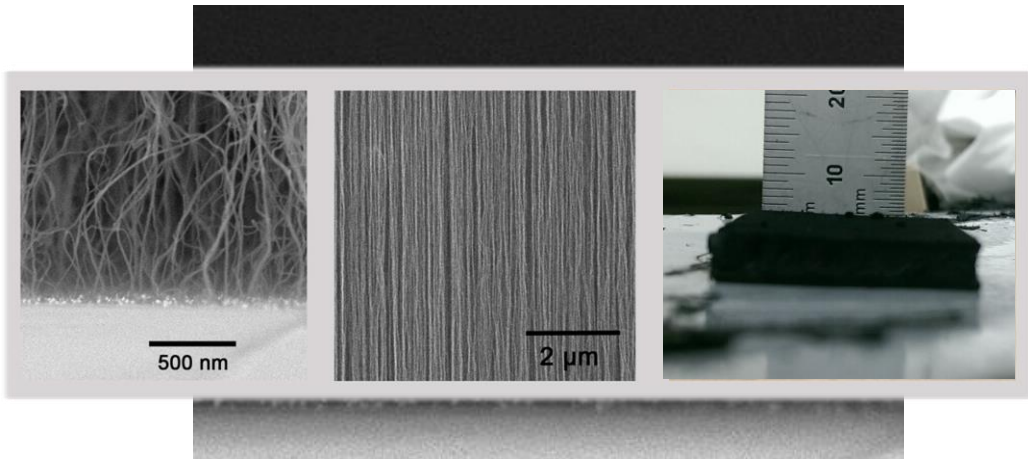
...liquid based processing creates bundled CNTs whose fabrics loose functionality



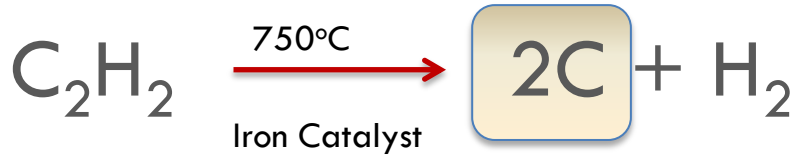
Length/diameter ratio: 100-1000



How Do We Produce Our MWCNTs?



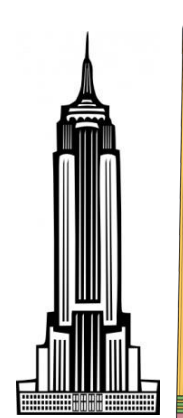
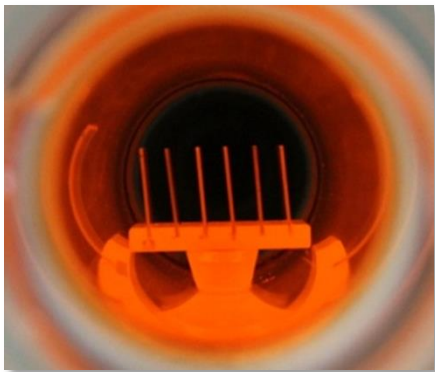
Length-to-diameter ratio of
~ 100,000



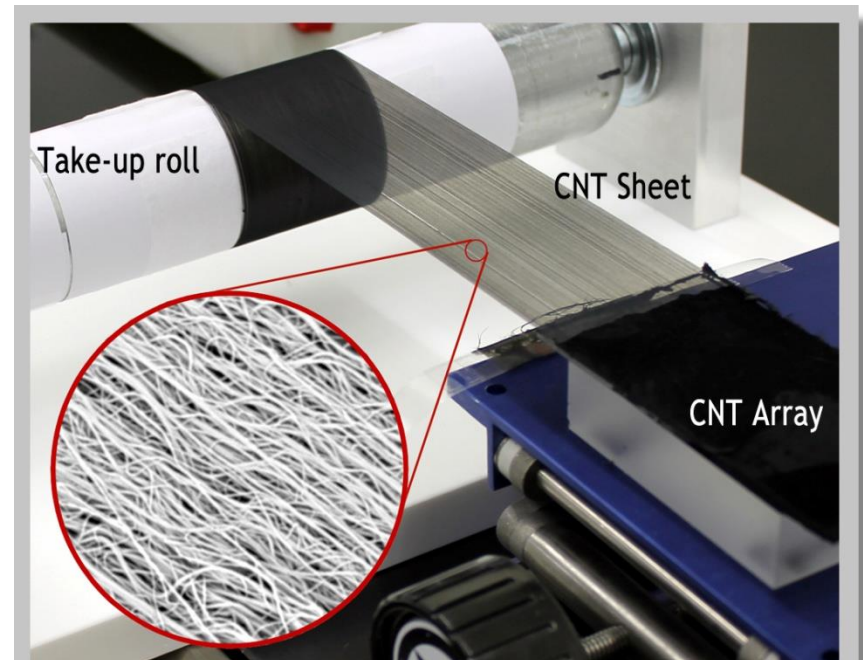
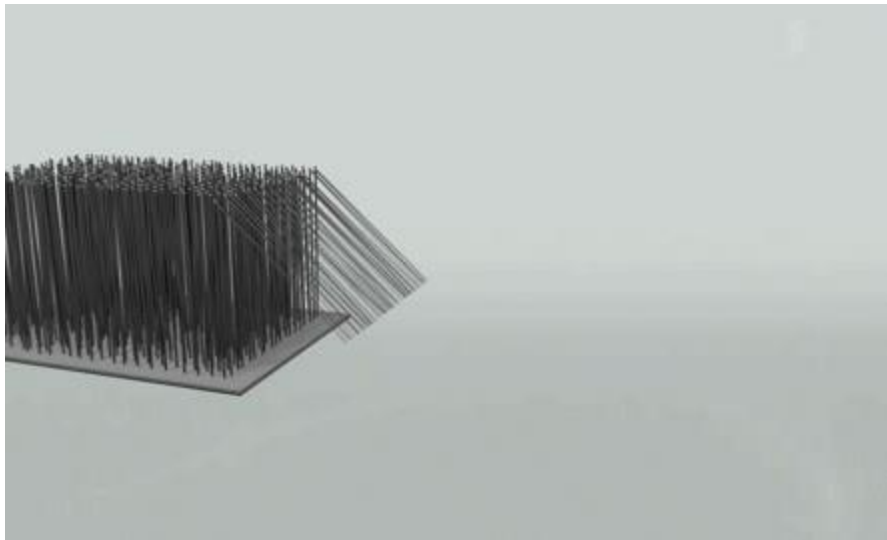
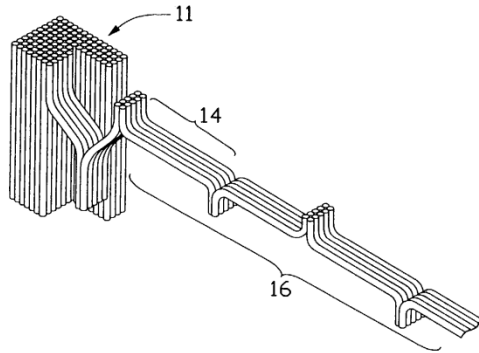
This is same as...

...a human hair that is 30 feet long!

... a pencil that is half a mile long!

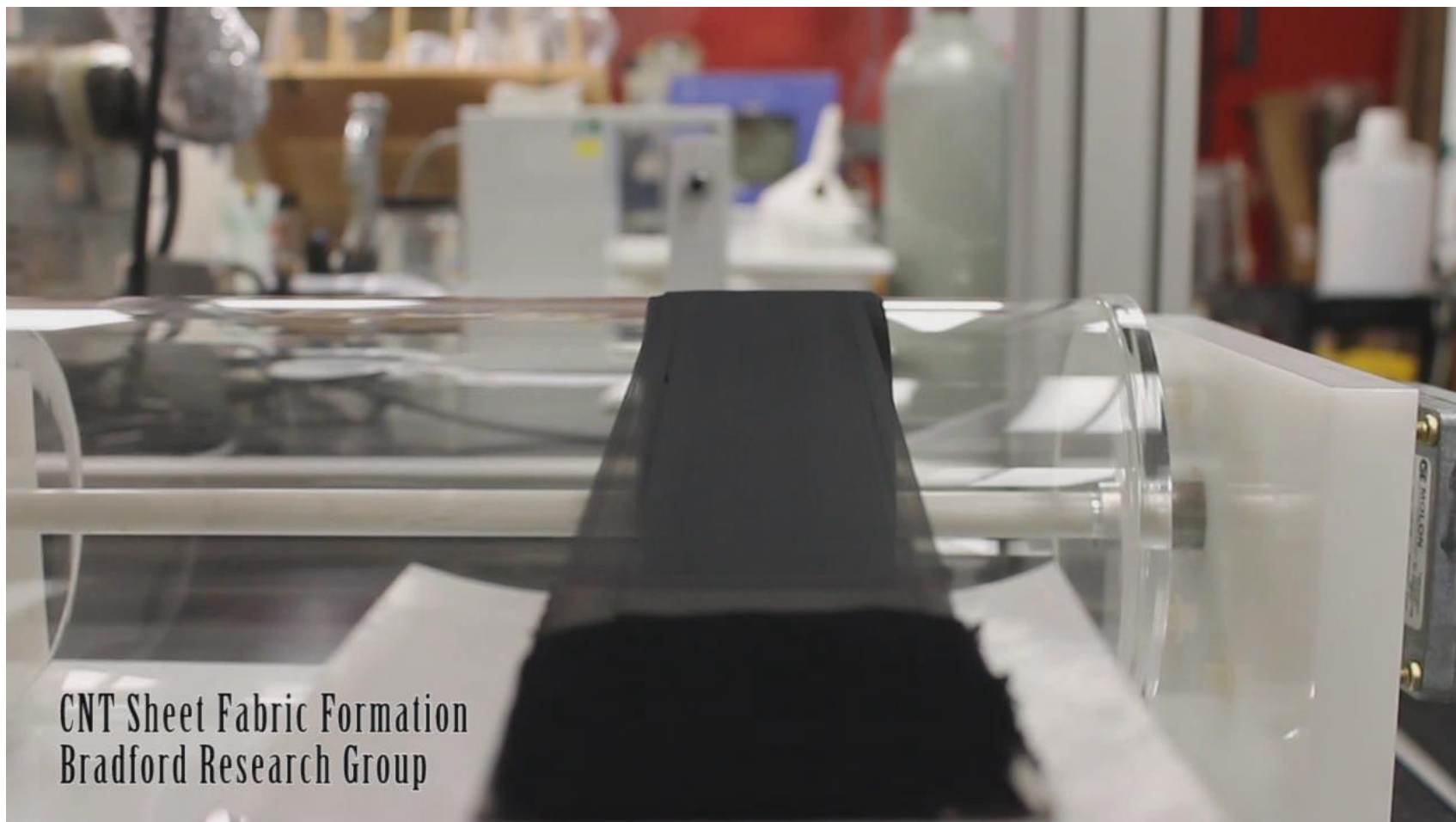


Drawable CNT Sheets



Aligned carbon nanotube sheets
being taken up on a roller

Carbon Nanotube Sheet Take-up

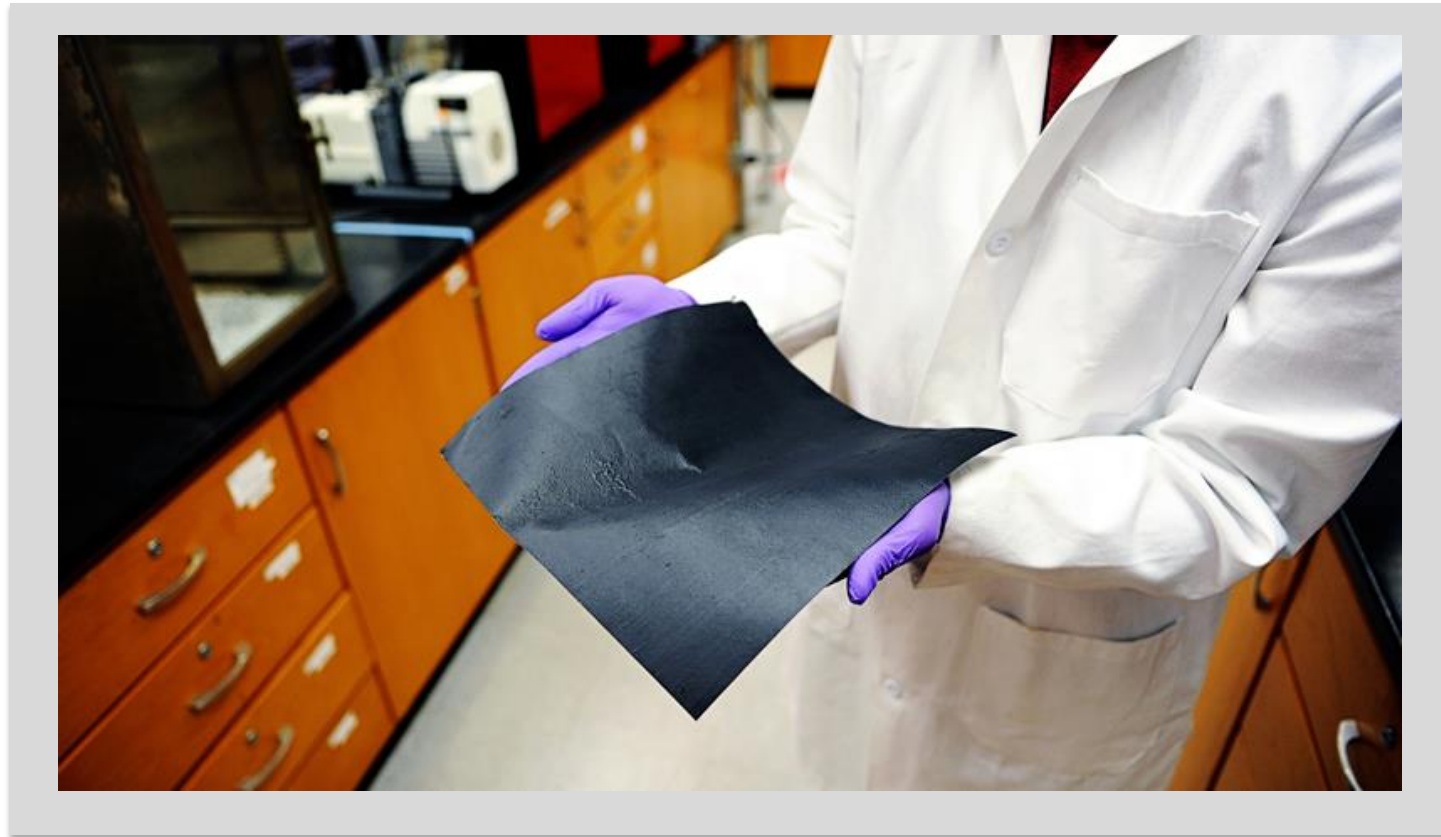


CNT Sheet Fabric Formation
Bradford Research Group



CNT Sheet Nonwoven Fabrics

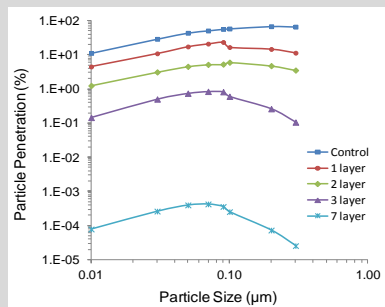
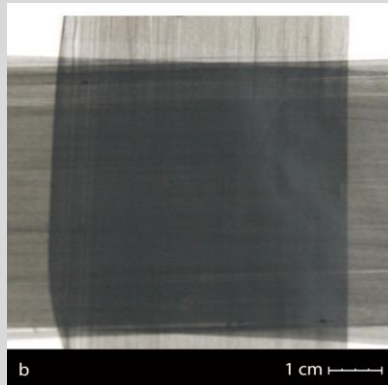
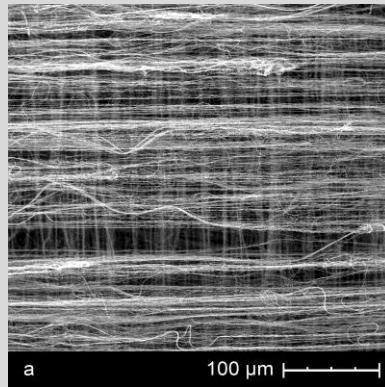
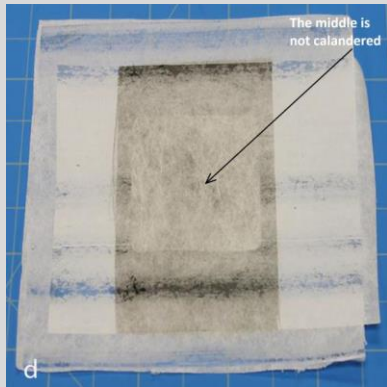
- If mandrel or CNT sheet is traversed during take-up, larger pieces of fabric can be created





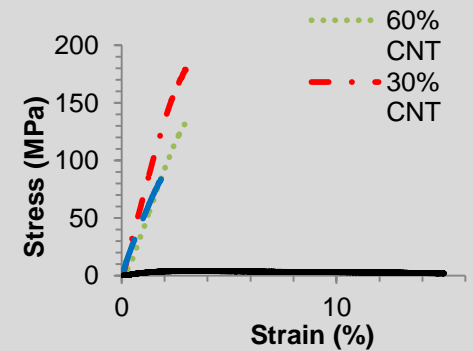
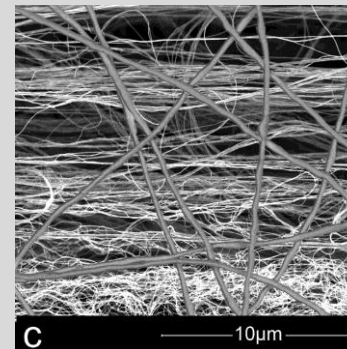
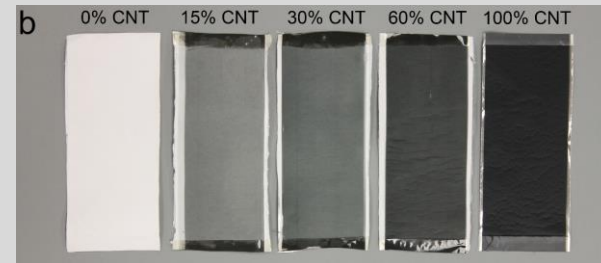
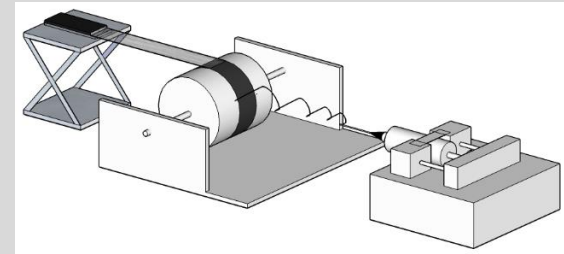
Applications We are Exploring

Aerosol Filtration



Yildiz O. and Bradford P. *Carbon*, 2013, 64:295-304.

High Strength Hybrid Nanofiber Fabrics



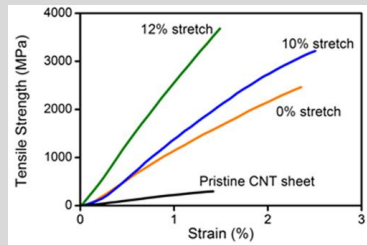


Applications We are Exploring

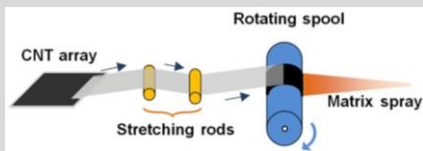
High Performance Composites



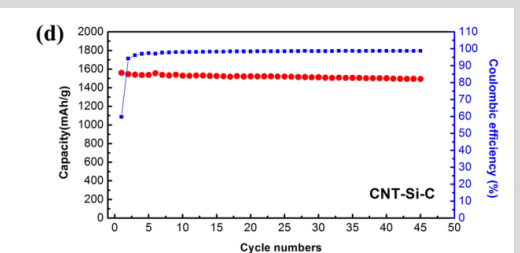
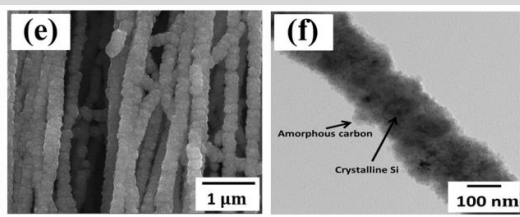
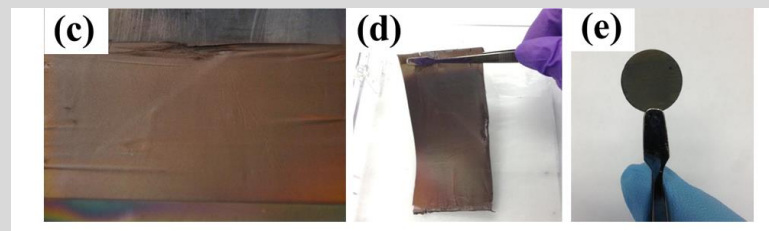
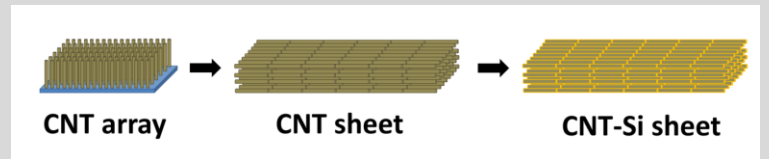
Stano K. et al., *ACS Appl. Mater. & Interfaces*, 2013



Wang X, et al, *Mater. Res. Lett.*,(1) 2012



Battery Electrodes

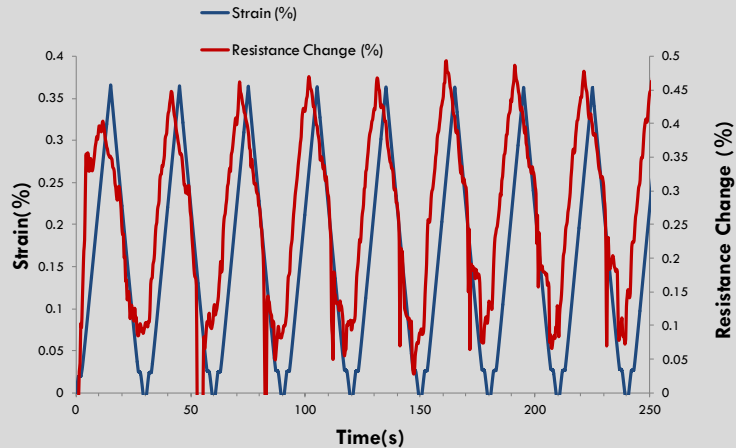
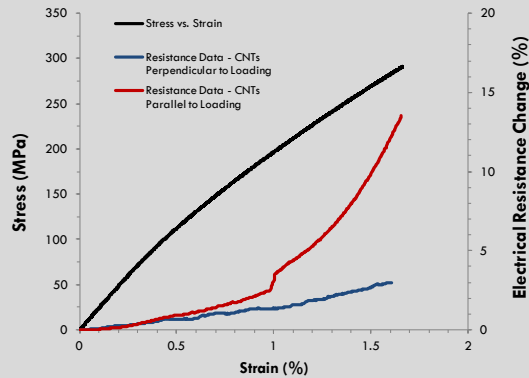
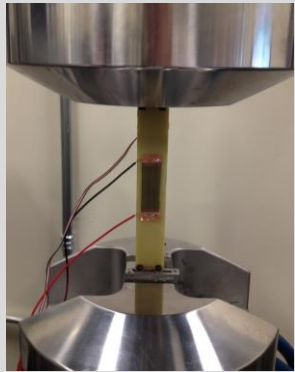


Fu, K., et al. *Advanced Materials*, 2013, 25(36):5109-5114.

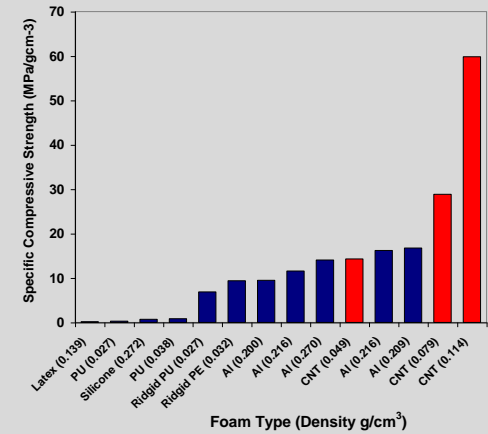
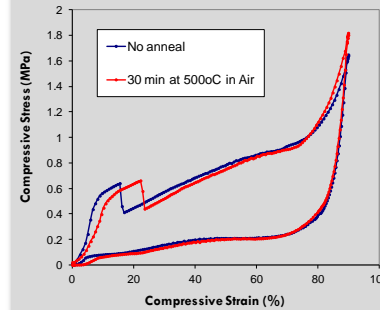
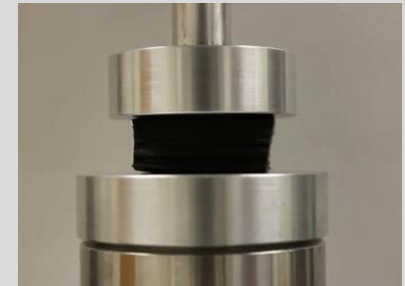
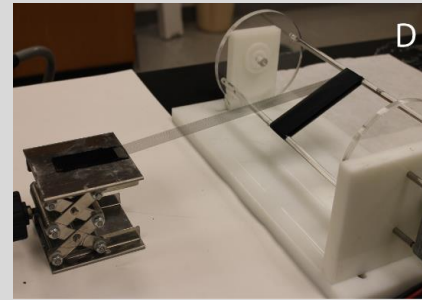


Applications We are Exploring

Strain Sensing



High Performance Foams





Research Made Possible By:

- Funding agencies

AFOSR

ACS

NC Space Grant

Eastman Chemical

NASA



- My group members:

Kelly Stano

Ozkan Yildiz

James Stahl

Shagheyegh Faraji

Kun Fu

Spencer Barbour

Ang Li

Karim Aly

Jincheng Zhu

Thank you for your attention!

Contact Information

philip_bradford@ncsu.edu

919-515-1866

www.go.ncsu.edu/Bradford