

Fabrication and Mechanical Testing of Nanowire Array Reinforced Nanocomposites

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Relevance to NASA:

- 2006 NASA Strategic Plan

goal 1: Fly the Shuttle as safely as possible until its retirement...

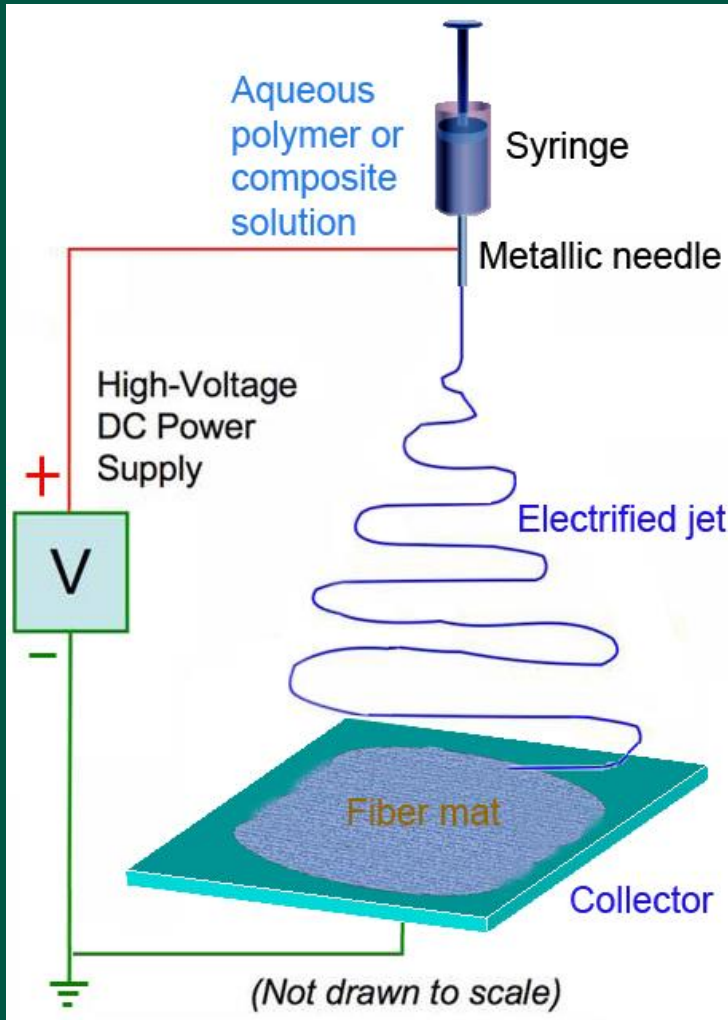
goal 3: NASA's Aeronautics Research advances knowledge in core disciplines (including materials) to enable breakthroughs in Aeronautics."

- New light and strong materials are considered as one of the key ways to crew and space shuttle safeties, as well as improvement of fuel efficiency.

- This research could impact "various areas of interest to NASA, including structural composites, radiation shielding, air filtration, energy storage, etc". (Brett Cruden, NASA Ames Center for Nanotechnology)

Planned Instrument setup

Electrospinning schematic



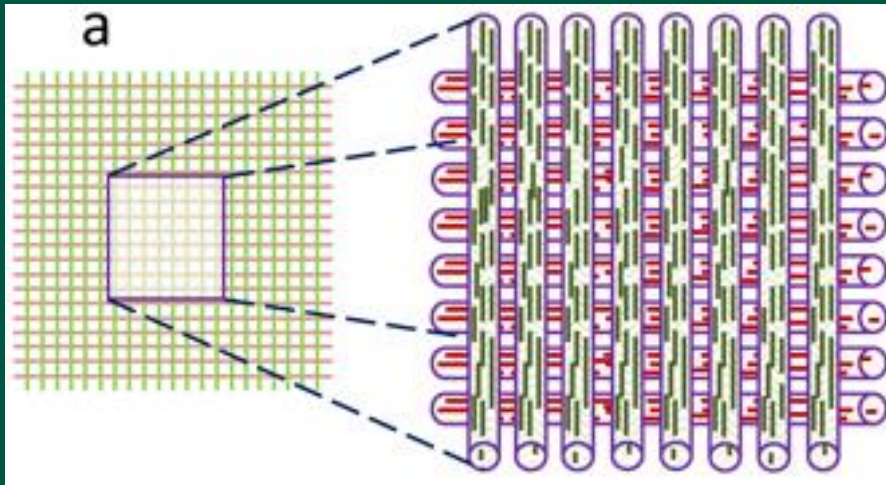
Progress

Electrospinning setup



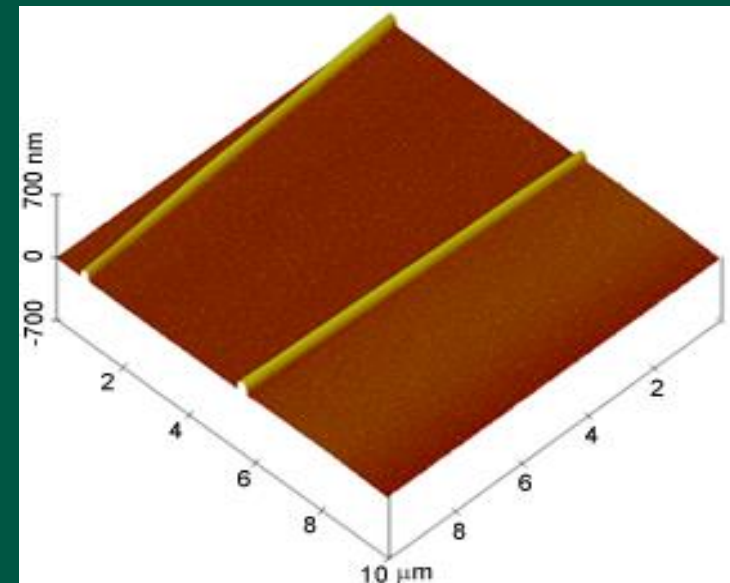
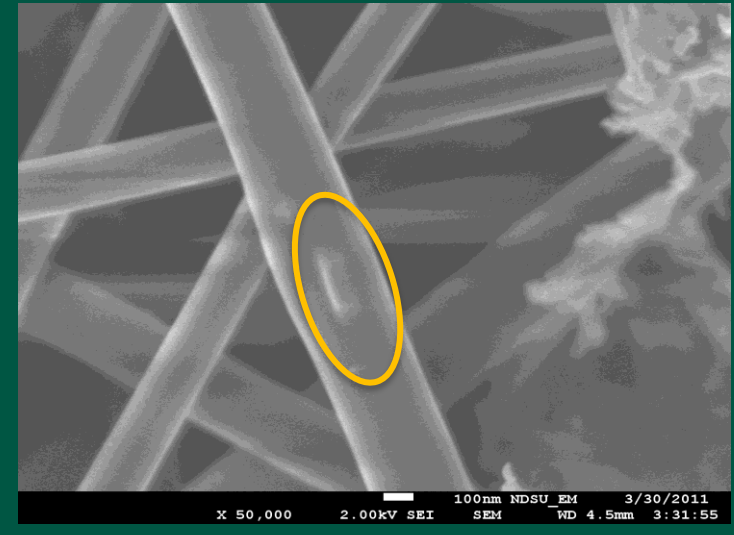
Planned Fabrication

Schematic of co-electrospun fiber array



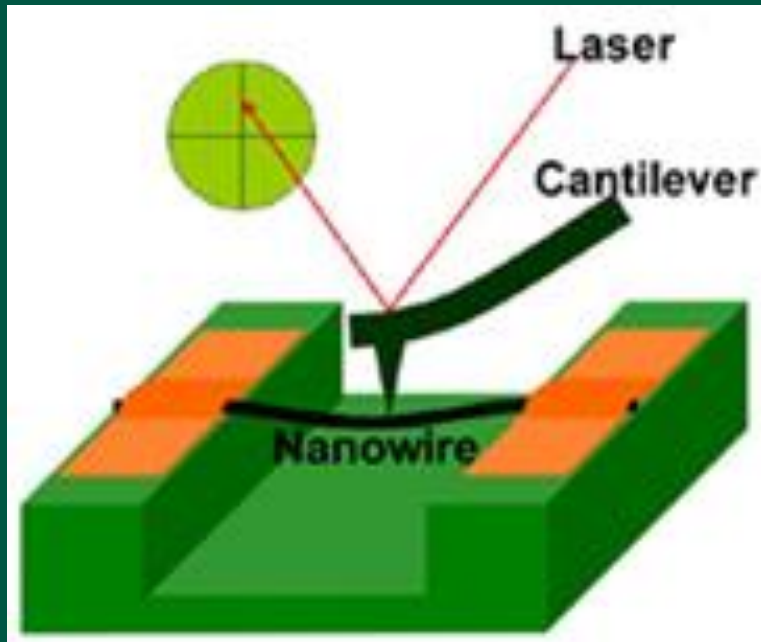
Progress

Electrospun fiber



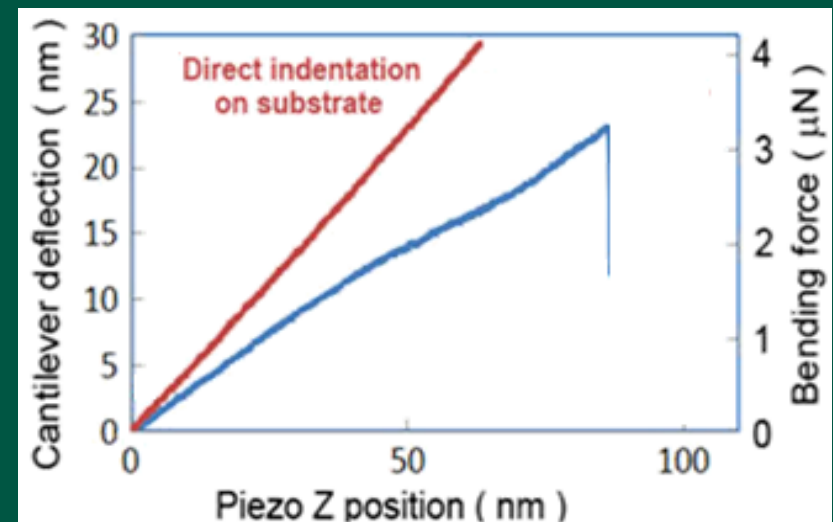
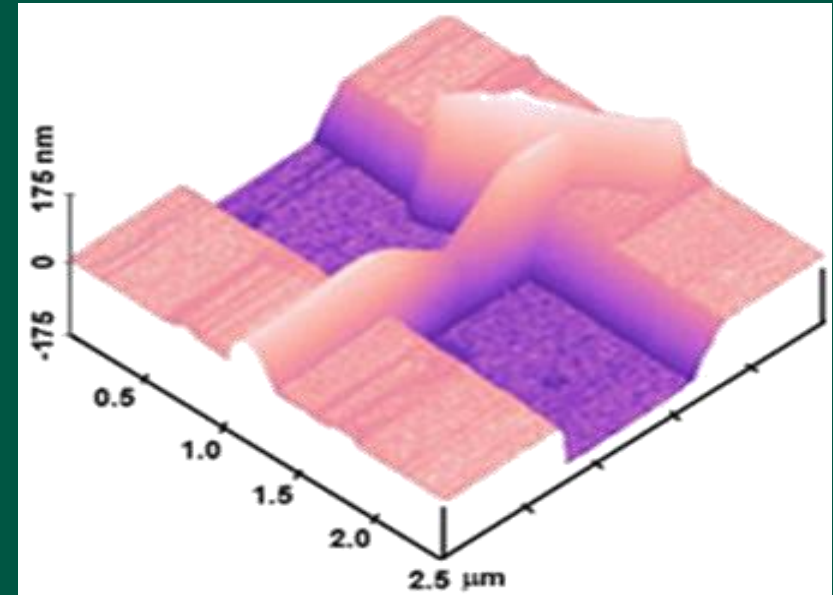
Planned Mechanical testing

Mechanical testing on individual nanowires



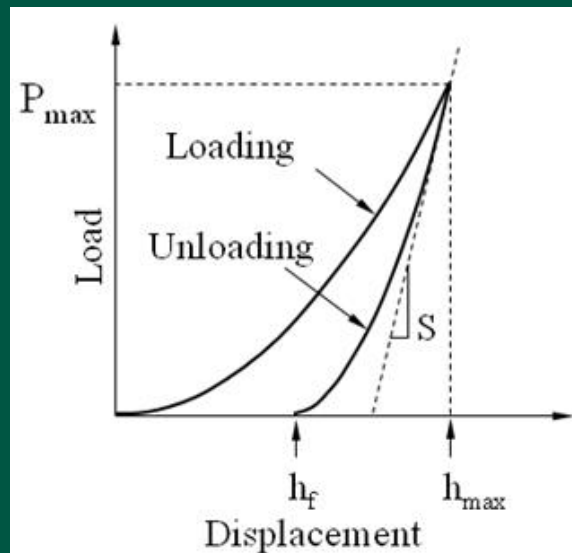
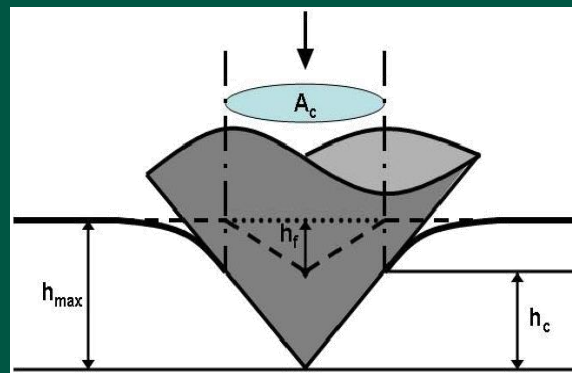
Progress

3-pt bending on $\text{Mg}_2\text{B}_2\text{O}_5$



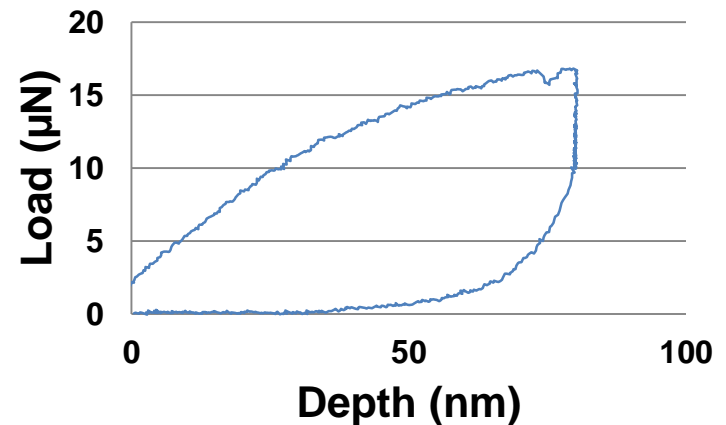
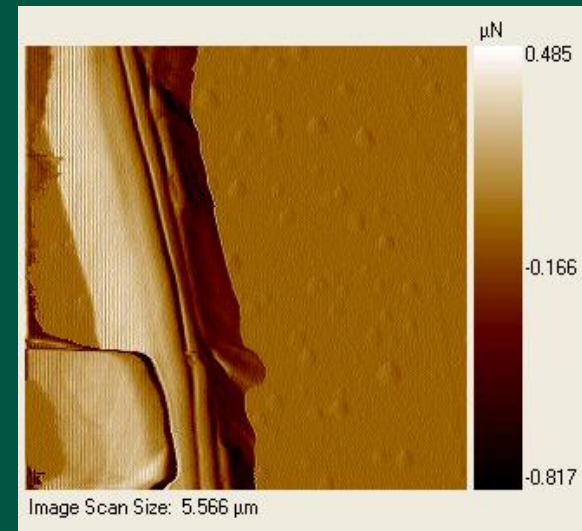
Planned Mechanical testing

Mechanical testing on
as-electrospun fiber



Progress

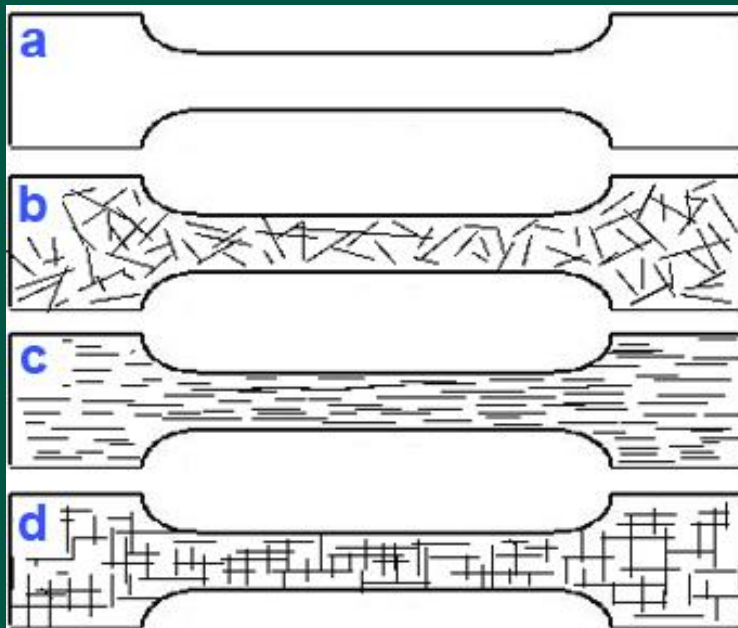
Nanoindentation on PVA
electrospun fiber (12 wt%)



Planned Mechanical testing

Mechanical testing of
dogbone specimens

- make dogbone specimens
- design a tensile tester

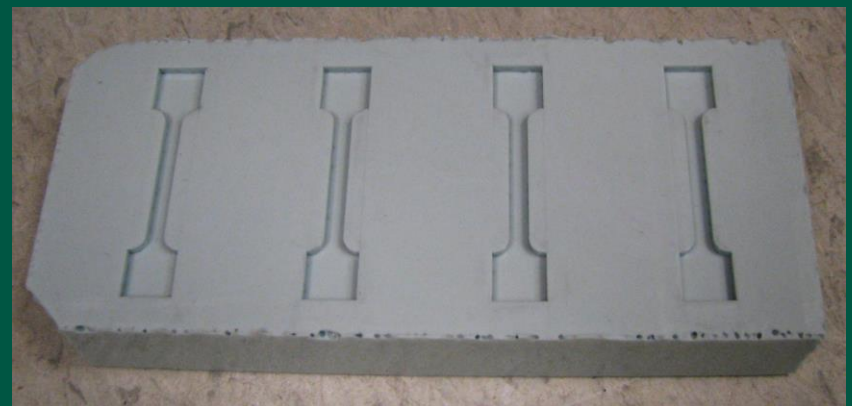


Progress

Dogbone die design



Male mould



Female mould

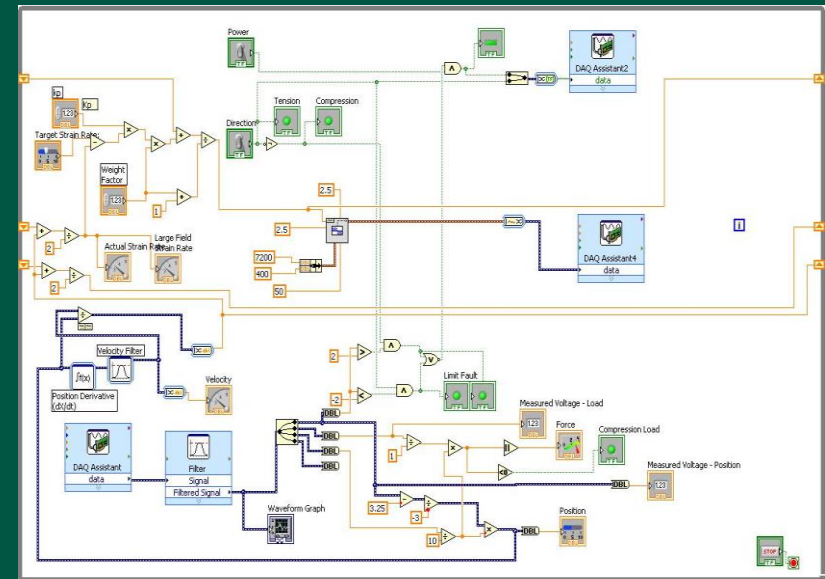
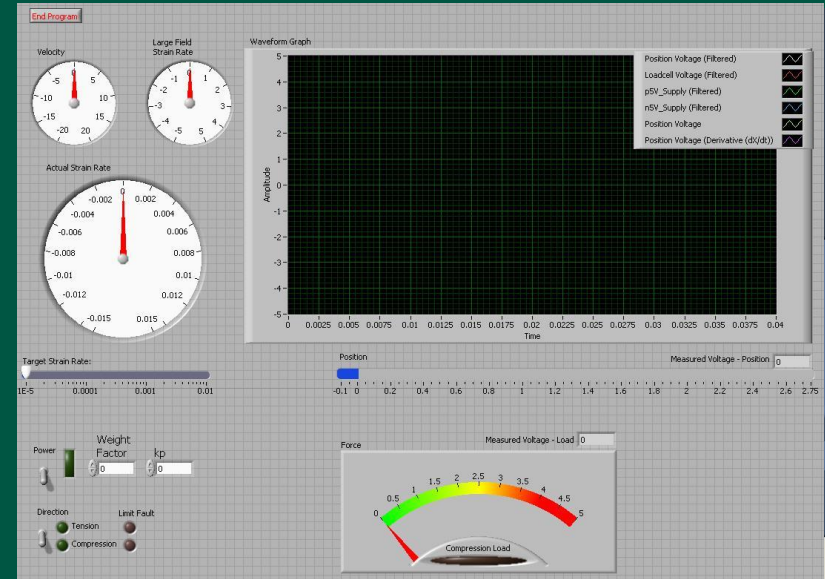
Planned Mechanical testing

Mechanical testing of dogbone specimens

- make dogbone specimens
- design a micro/nano tensile tester

Progress

Hardware | Software



Collaborations:

- Prof. Annie Tangpong (ME, NDSU)
- Prof. Majura Selekwa (ME, NDSU)
- Prof. Xiangfa Wu (ME, NDSU)
- Prof. Chad Ulven (ME, NDSU)
- Prof. Nick Wu (MAE, West Virginia U)

Student involvement:

- Wyatt Leininger (ME grad, NDSU)
- Marshall McNea (ME undergrad, NDSU)
- Zhengping Zhou (MNT grad, NDSU)

Publications:

X. Wang, *et. al.*, “Capillary force induced elastic deformation on ZnS nanobeams” Proceedings of the ASME 2011 (*Best Paper nominee*)

Future plans:

- Exchange information with *NASA Ames Center for Nanotechnology*;
- Publish experimental results;
- Get further involved with NASA through Summer Research programs;
- Extend future proposals to nanocomposite friction damping (NASA's noise control mission).

Thank you!