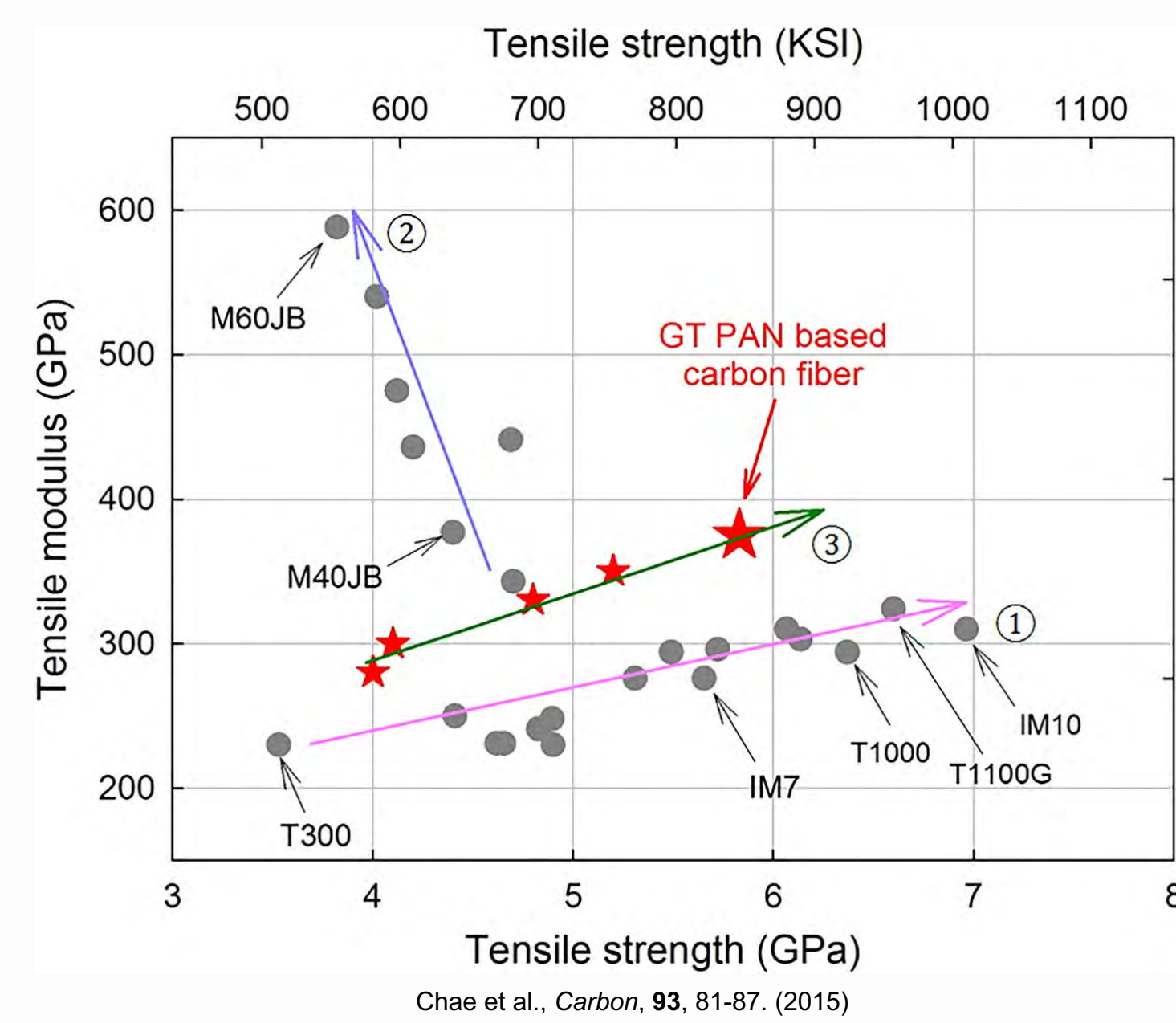
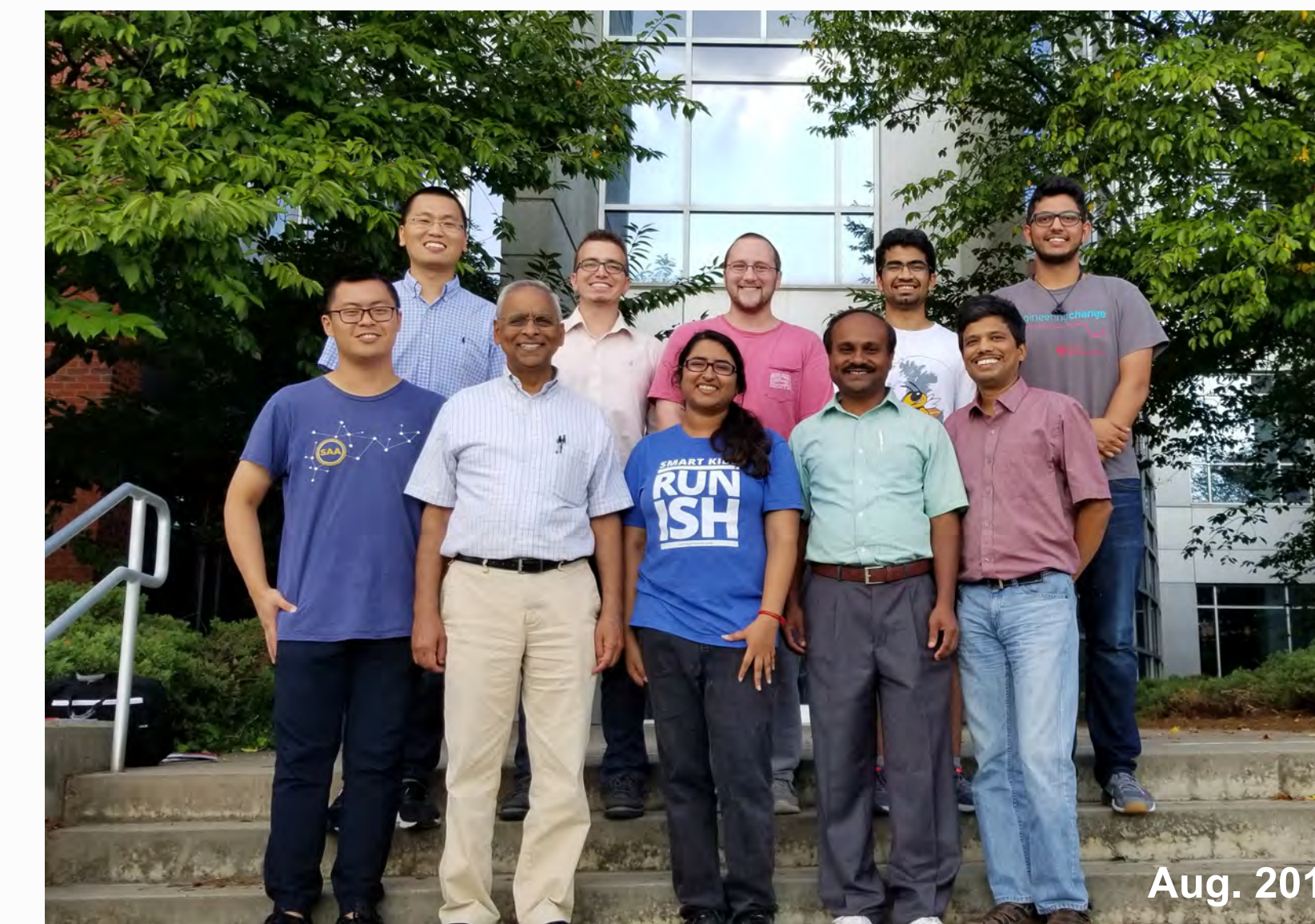


# Carbon Fiber Manufacturing



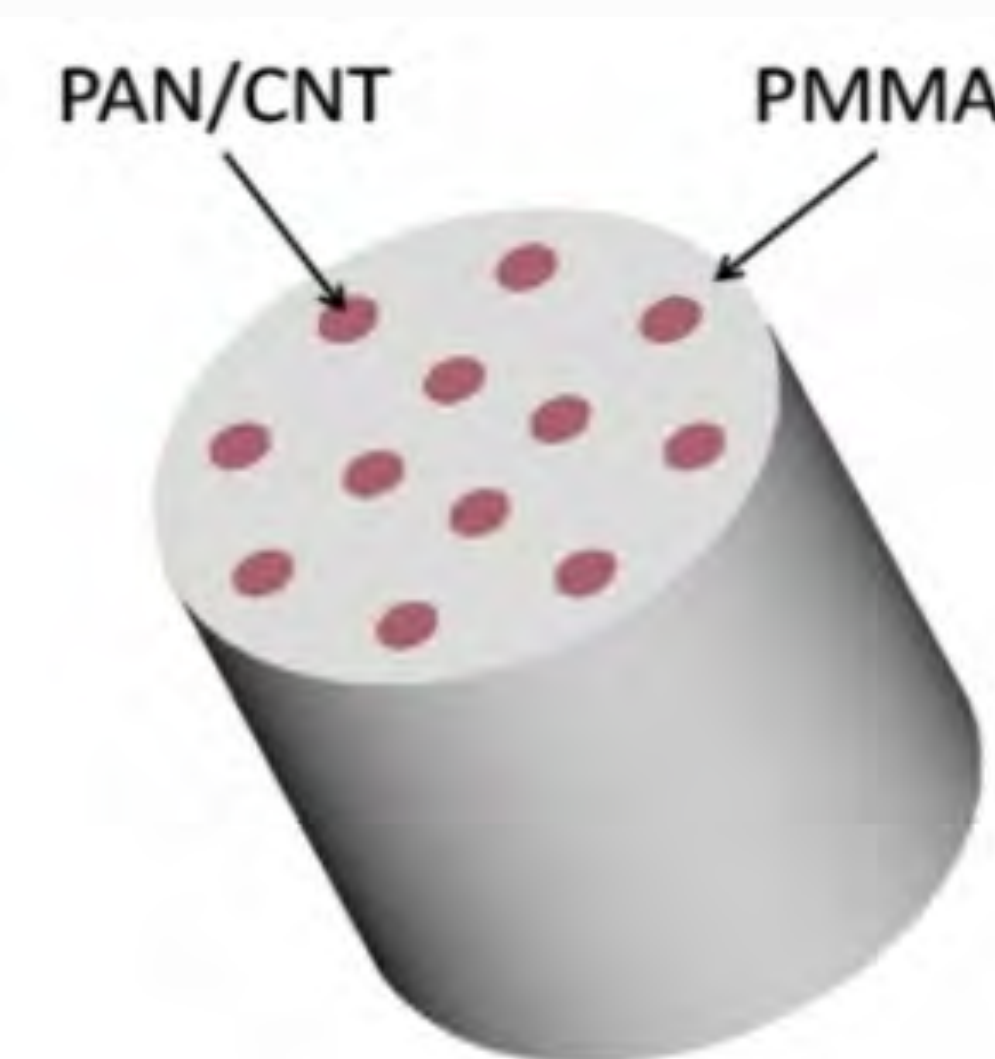
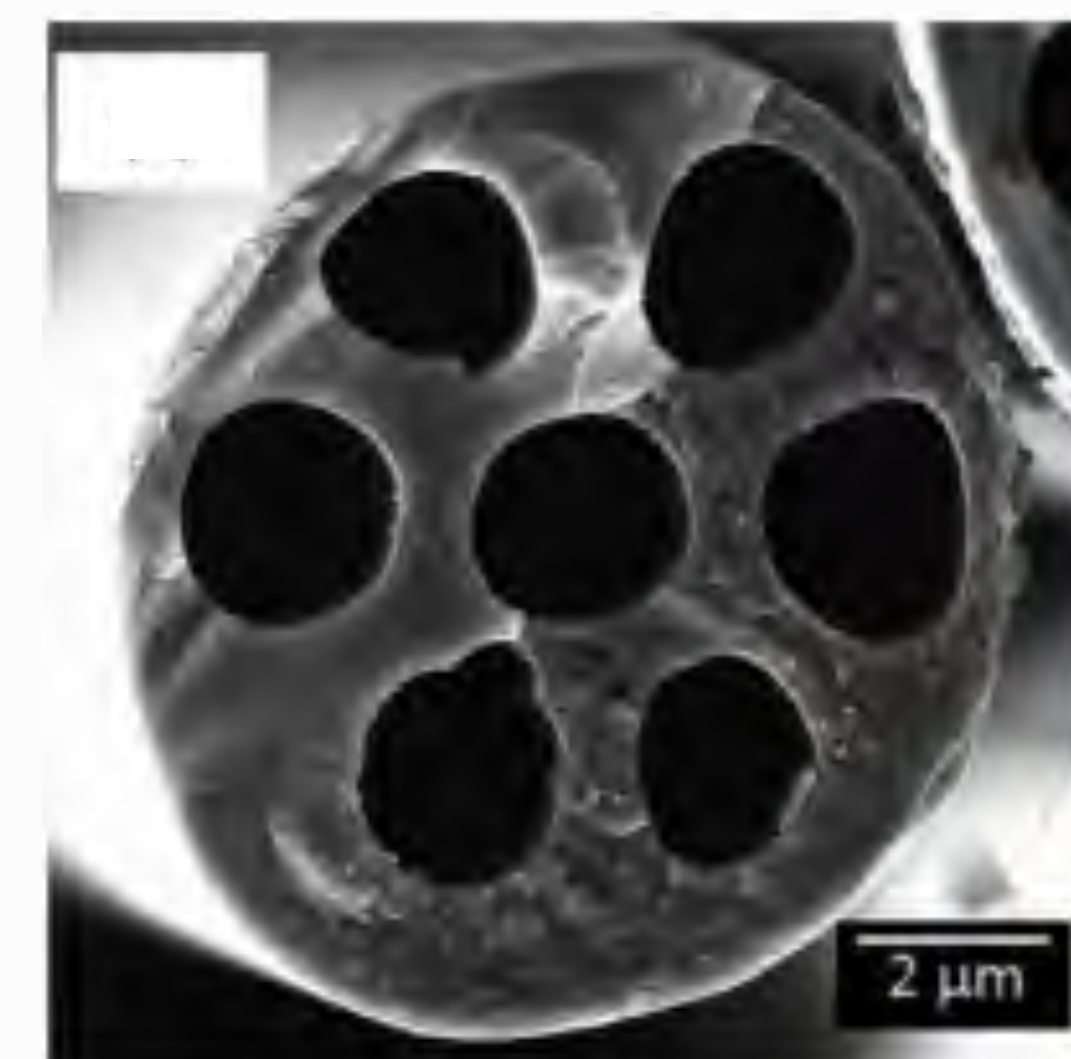
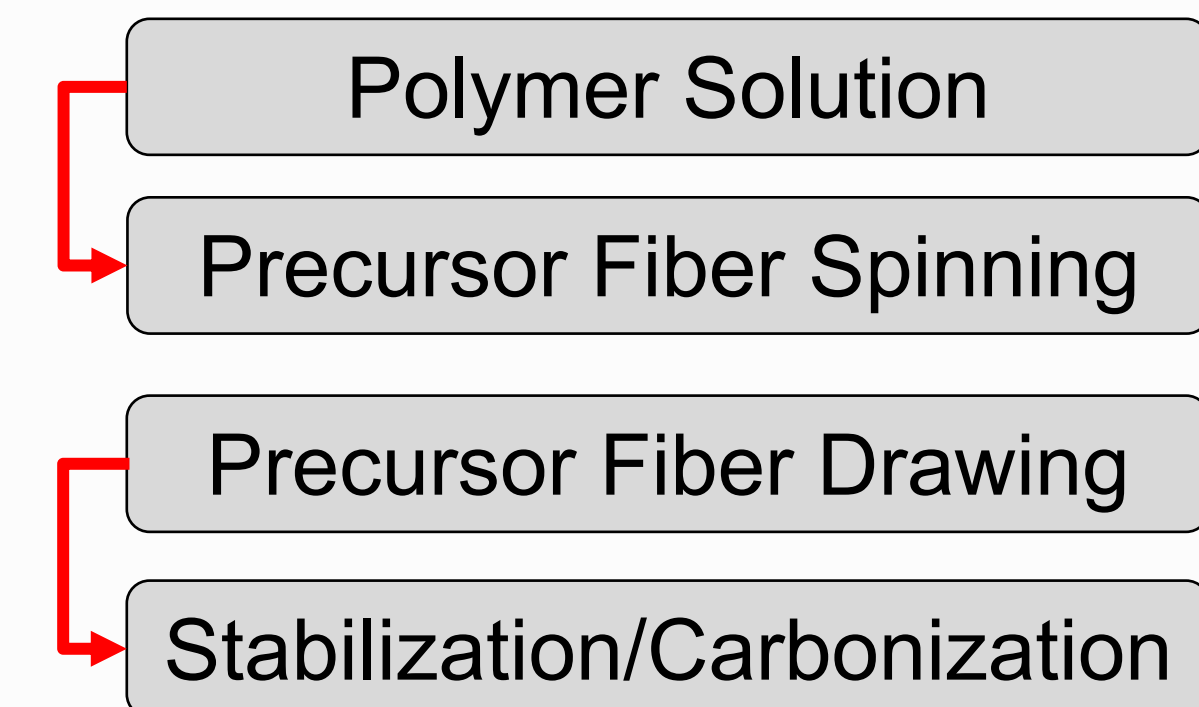
Sponsors:

AFOSR, AFRL  
Boeing, EPA, DOE  
DARPA, Fulbright  
NASA, ARPA-e



### Properties

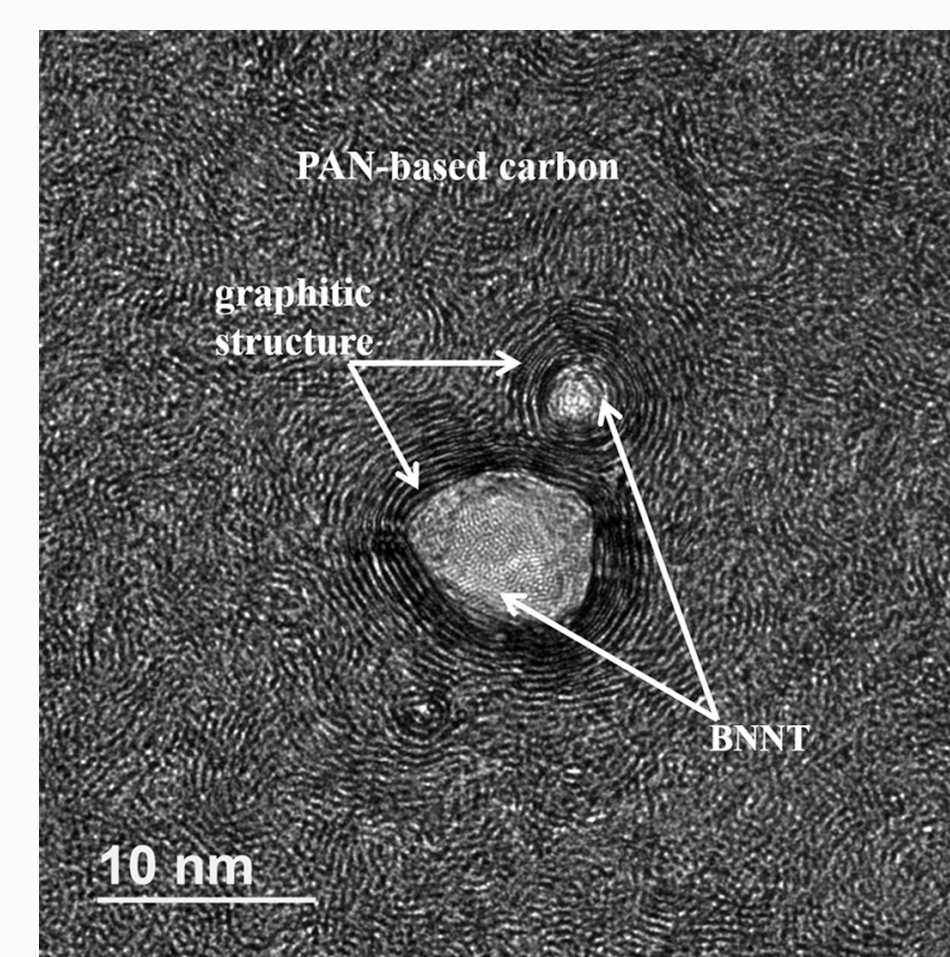
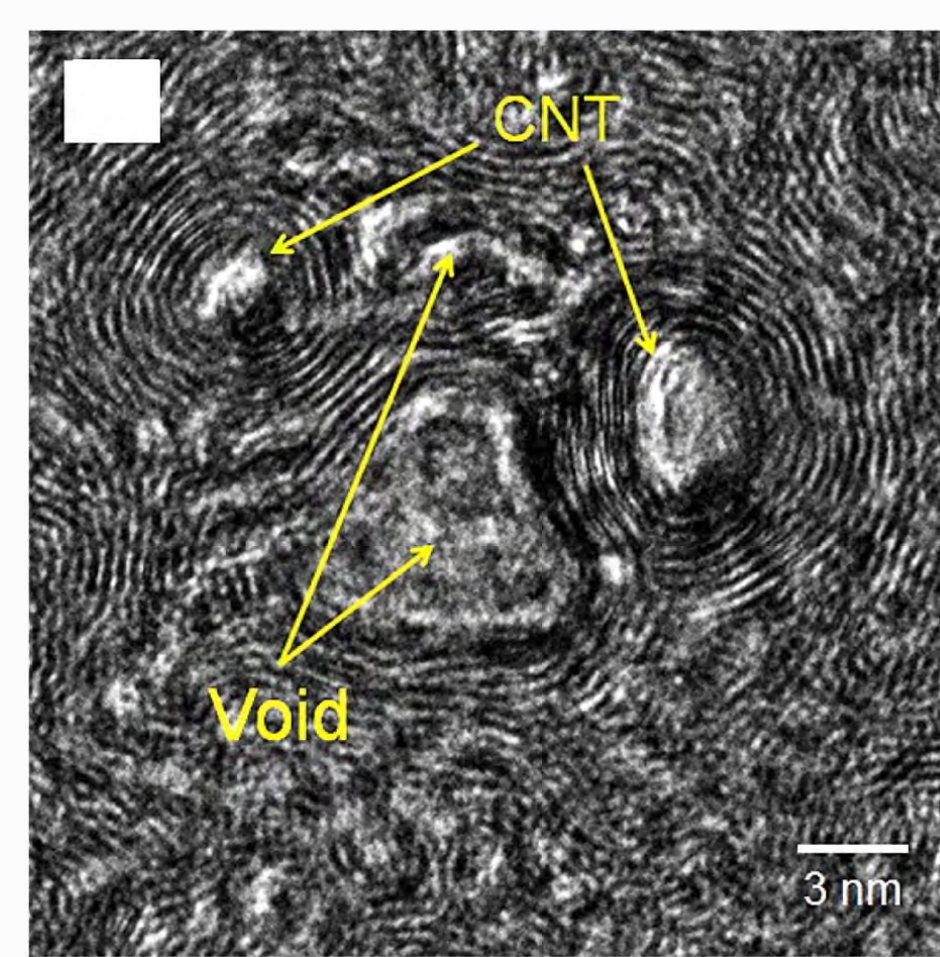
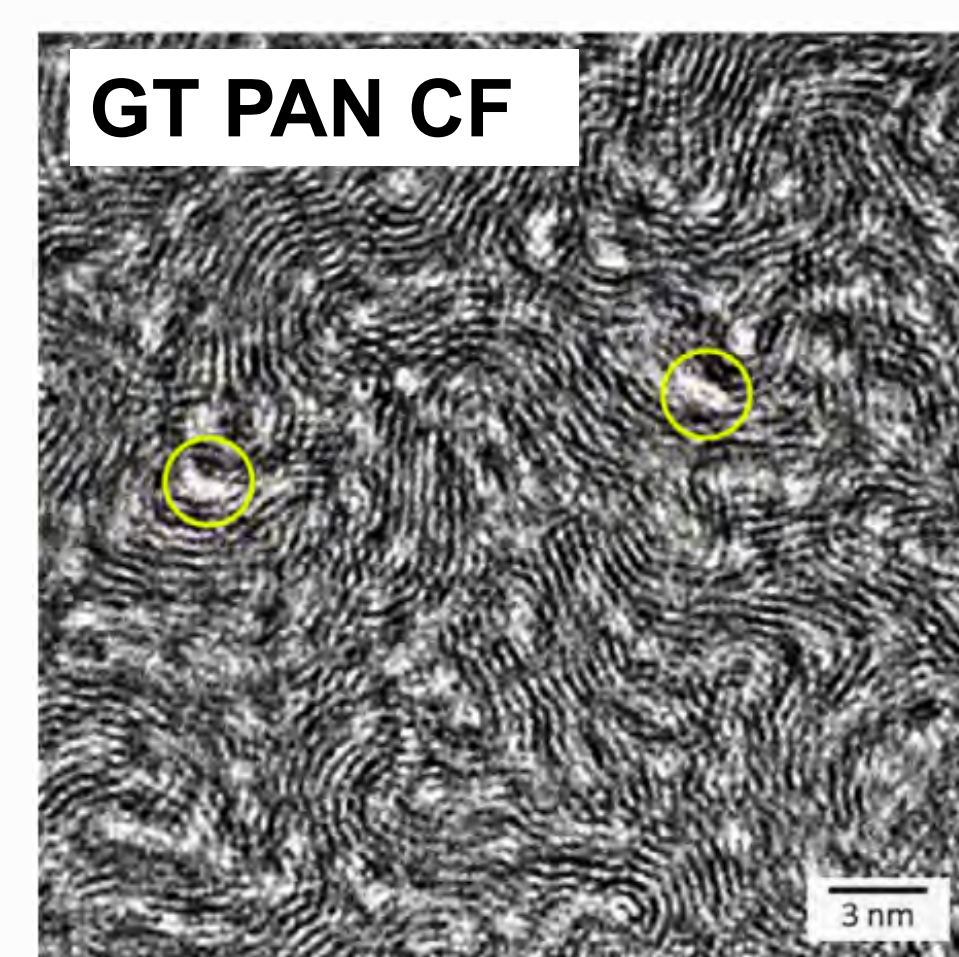
- 1/4 the density of steel
- 5-10 times the specific strength of steel
- Reinforcement material in composites
- Currently, only ~10% of the theoretical tensile strength has been realized



Gulgunje et al. Carbon, 95 710-174, (2015)

### Precursor Fiber Processing in Novel Geometries

- Hollow Carbon Fiber
- Small Diameter Carbon Fiber

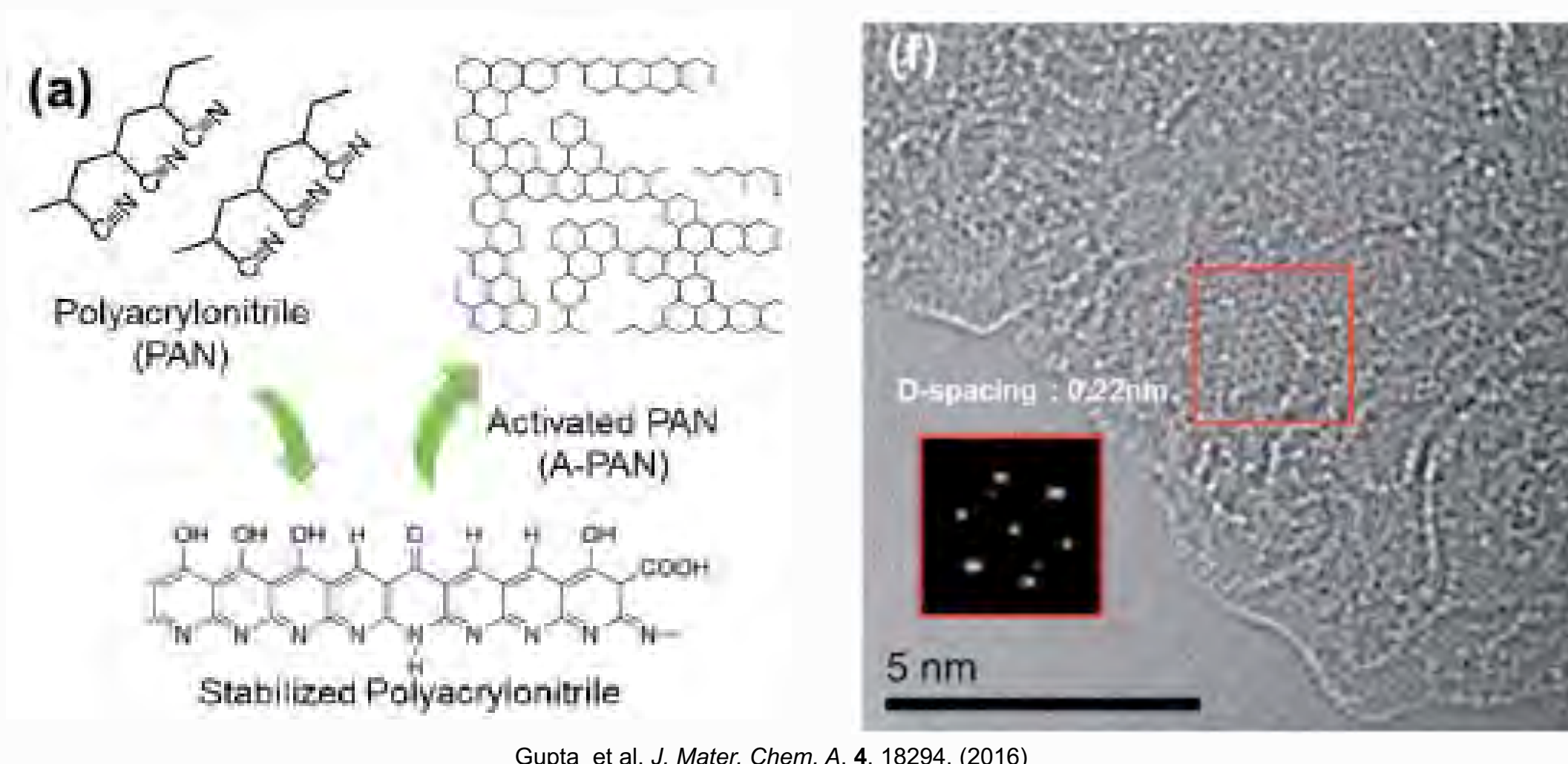


Chae et al., Carbon, 93, 81-87, (2015)

Newcomb et al., Carbon, 93, 502-514, (2015)

Chang et al., Carbon, 147, 419-426, (2019)

Graphitic structure (and properties) are being engineered by using nanofillers.



Gupta et al. J. Mater. Chem. A, 4, 18294, (2016)

High surface area carbon with a surface area of 3550 m<sup>2</sup>/g is synthesized via low-cost, scalable process from polyacrylonitrile.

**Carbon fiber**

**Polymer fiber**

**Nanocomposites**

**Activated carbon**

**High Performance Materials**

**Multifunctional materials**

**Mechanical properties**  
Electrical conductivity  
High surface area  
Microwave-assisted heating  
Low density materials

**Process development**   **Interphase tailoring**   **Material characterization**

# Research Facilities



Over 4,000 sq. ft. of class 1,000 cleanroom space for precursor fiber processing and carbonization.

- Single filament line and batch carbonization ovens
- Multifilament line (pilot-scale) and continuous carbonization ovens.

### Part of PRIME LAB:

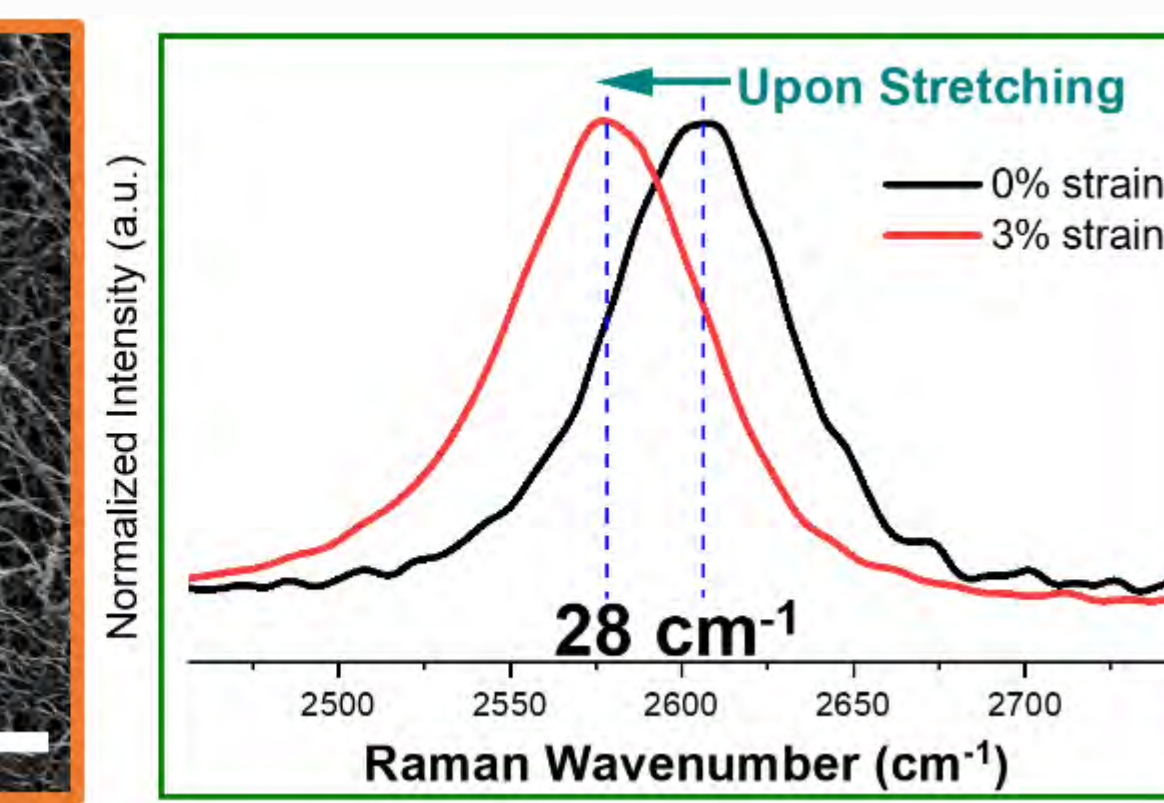
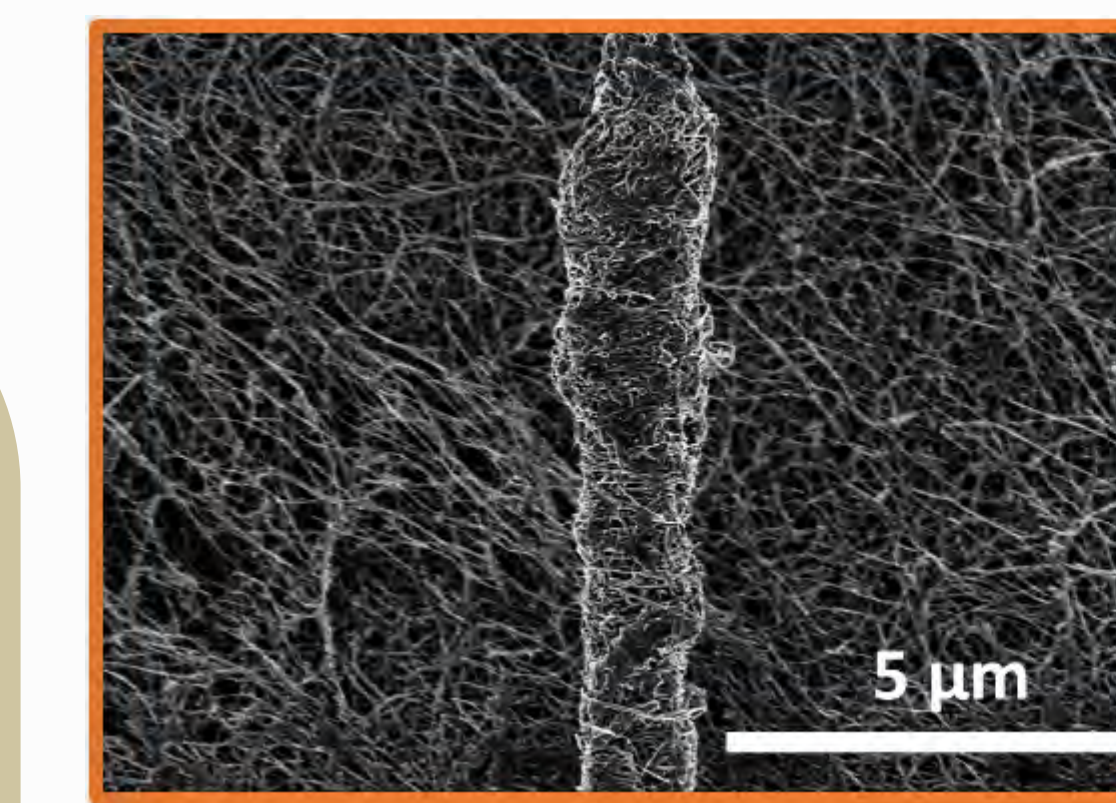
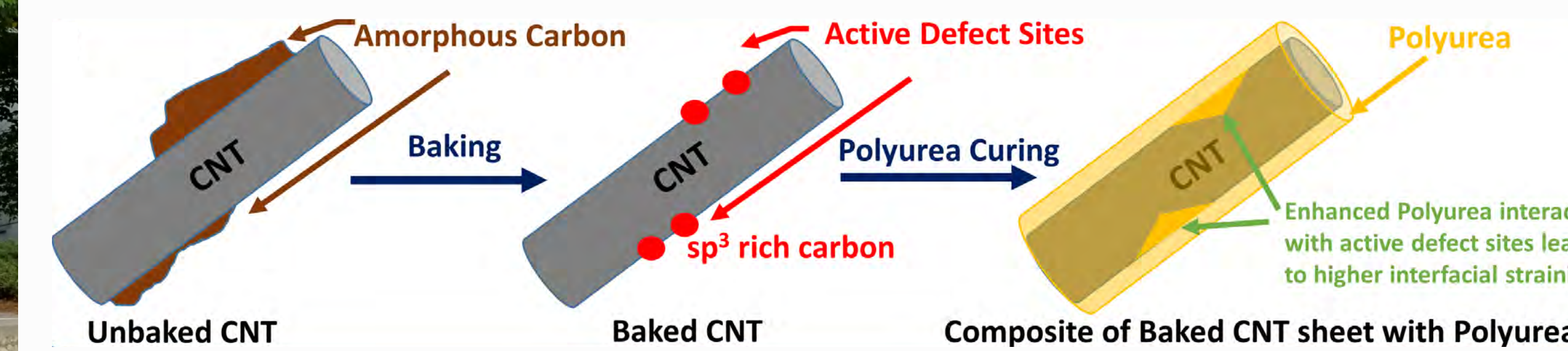
- Injection molding
- Micro-compounder
- Mini-compounder
- Pelletizer

### In house characterization capabilities

- Tensile testing
- Thermal analysis (DSC, TGA, DMA)
- Solution rheology (parallel plate, cone/plate)
- Chemical analysis (FT-IR, Raman)
- Dynamic light scattering
- Four-point probe electrical conductivity
- Wide angle X-ray diffraction (WAXD)
- BET surface area measurement

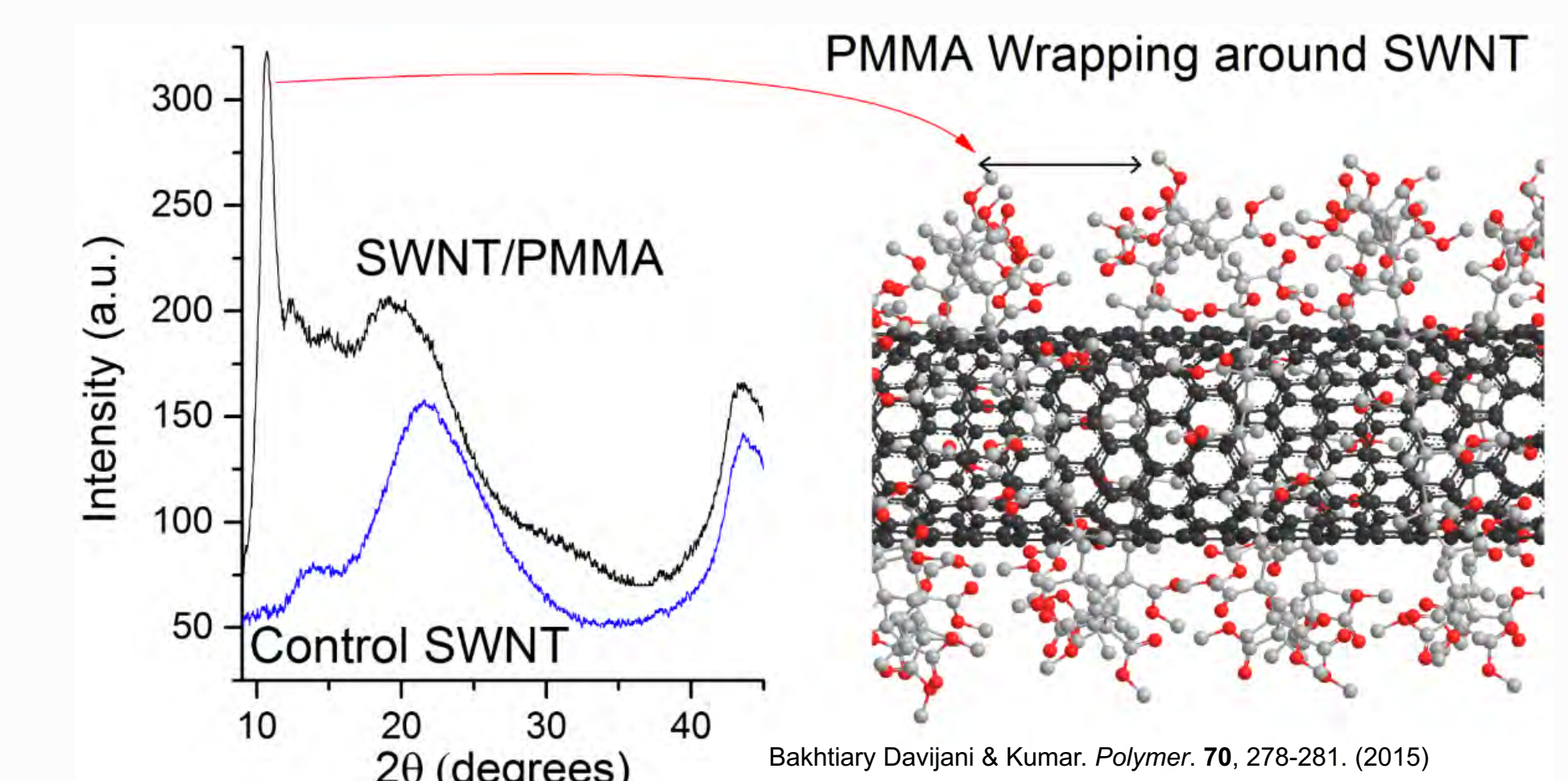


# Polymer Composites



Kimani et al., ACS Applied Nano Materials (accepted)

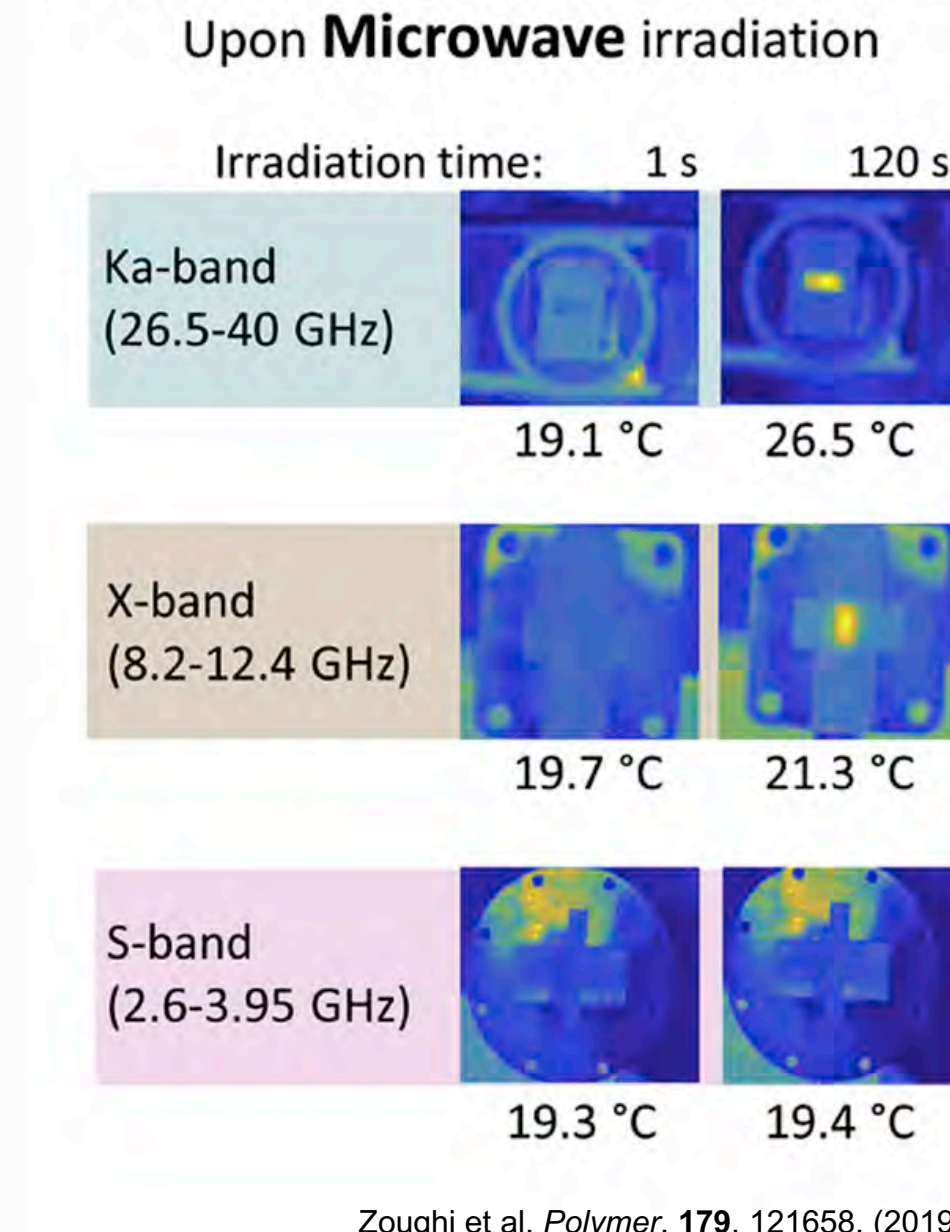
CNT sheets, baking and polyurea infiltration/curing



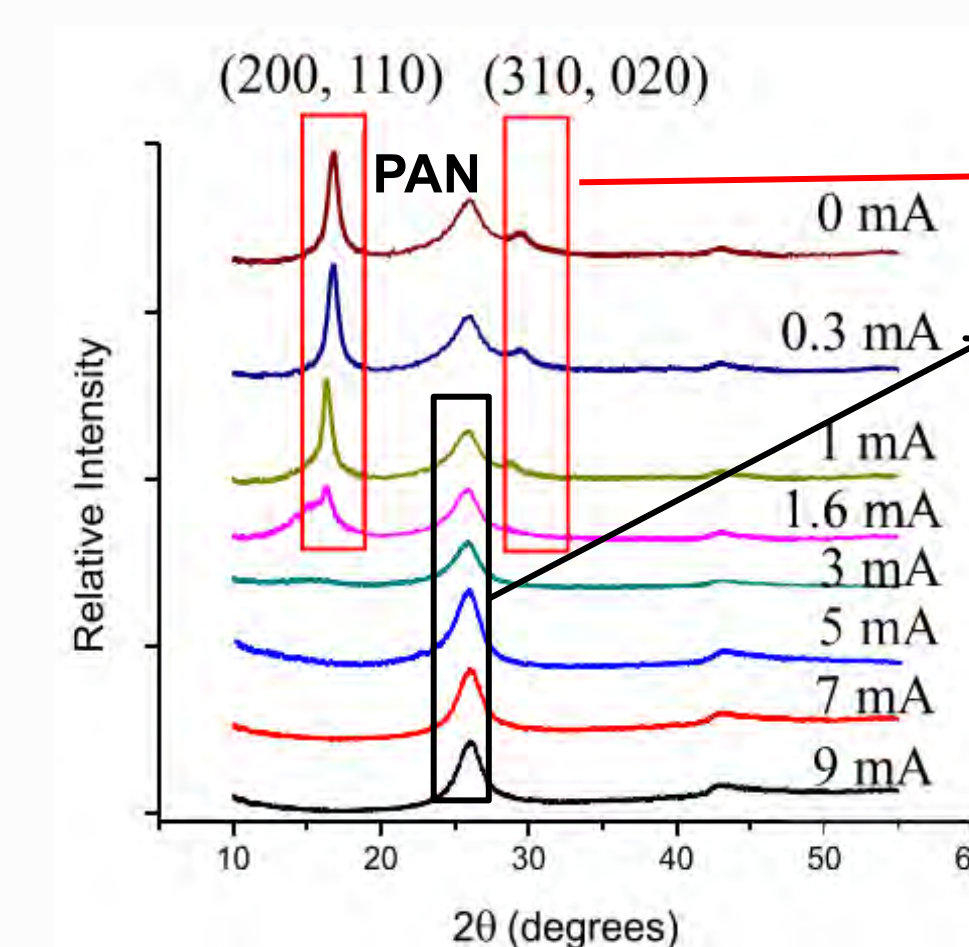
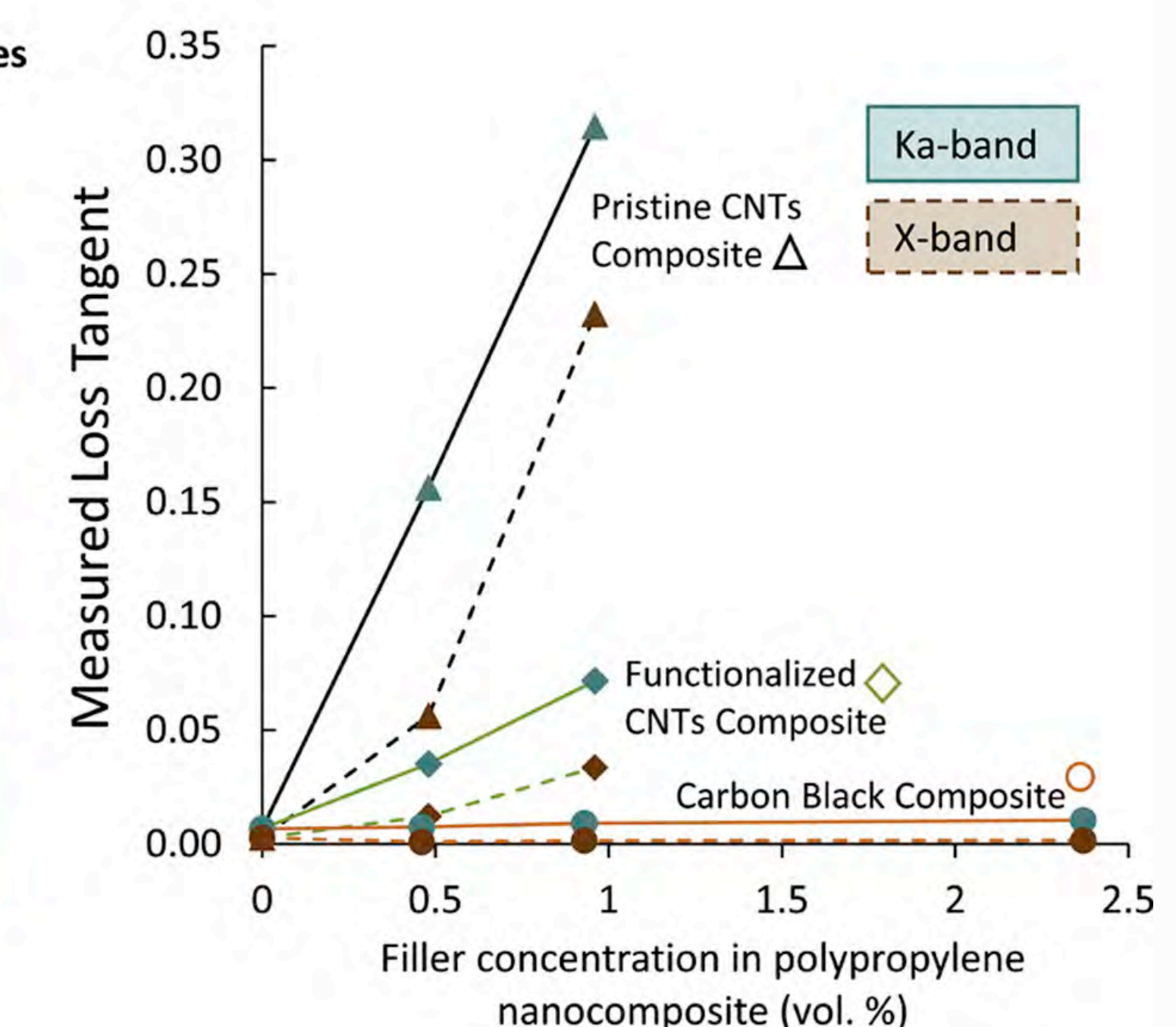
Bakhtiyar Davijani & Kumar. Polymer, 70, 278-281, (2015)

a-PMMA ordered helical wrap of SWNT

### Thermal response of Polypropylene/pristine MWNT composites Upon Microwave irradiation

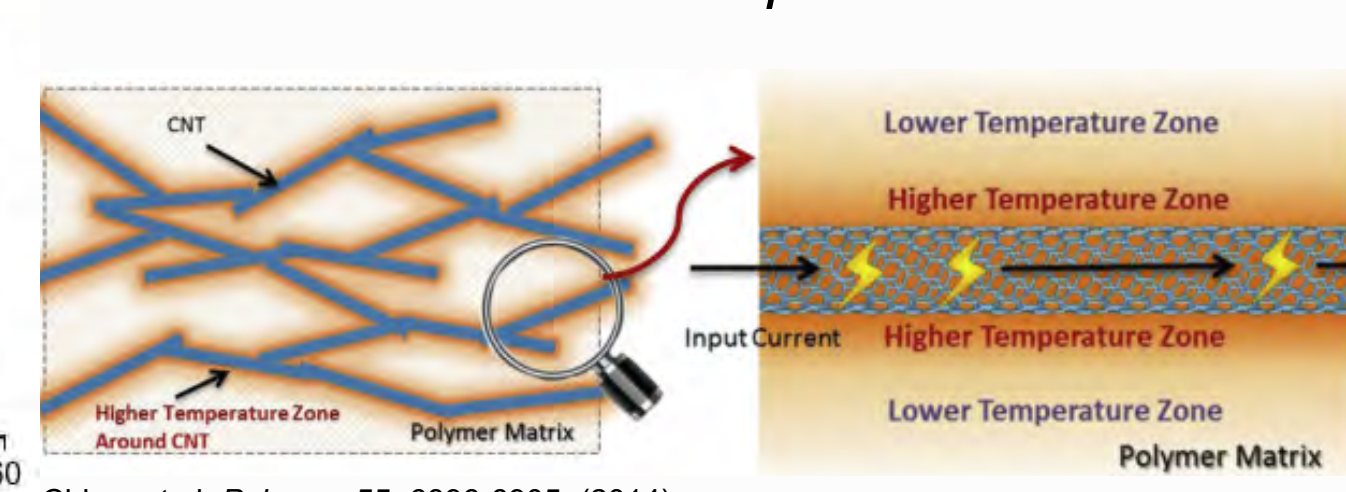


Zoughi et al. Polymer, 179, 121658, (2019)



### PAN fiber stabilization by Joule Heating

PAN structure diminished  
Stabilized ladderized polymer structure developed



Chien et al. Polymer, 55, 6896-6905, (2014)