CARBON MATERIALS GROUP

Carbon fiber composite material
SGL/BMW

UNIVERSITY OF KENTUCKY
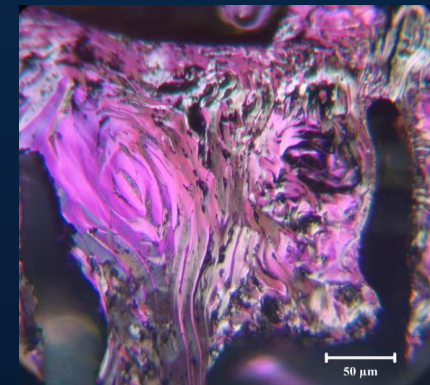
CAER
CENTER FOR APPLIED ENERGY RESEARCH

Dr. Matthew Weisenberger
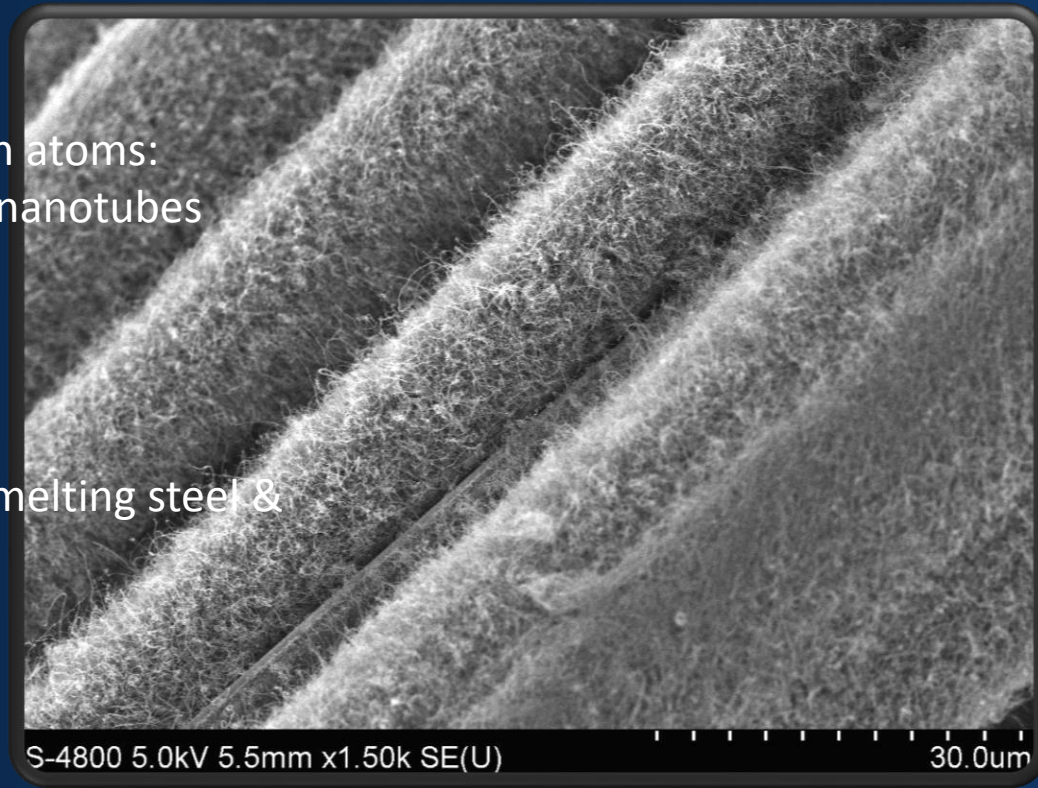Associate Director

Graftech

50 μm

- **What are carbon materials?**
  NOT CO_2.
  Matter assembled from *mostly* carbon atoms:
  graphite, diamond, fullerenes & nanotubes
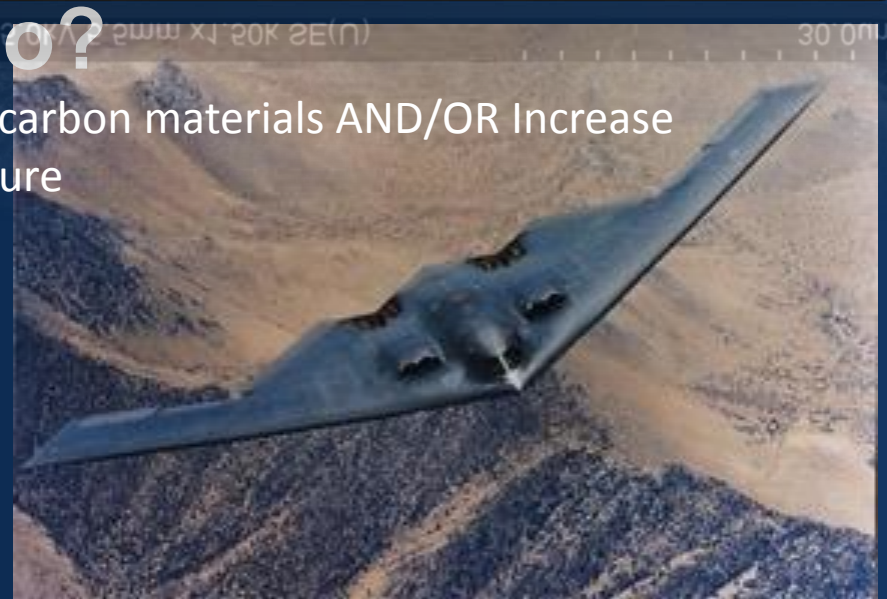
- **What are C materials used for?**
  - ✓ *Carbon Fiber Composites*
  - ✓ *Graphite Heat Spreaders / Shields*
  - ✓ Electrodes for making primary Al, melting steel & Energy Storage devices
  - ✓ Thermal Interface Materials
  - ✓ Thermoelectric devices
  - ✓ Adsorbents (filtration/separation)

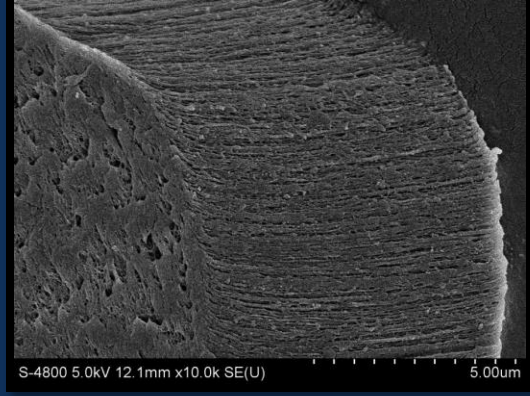S-4800 5.0kV 5.5mm x1.50k SE(U)   30.0um

What does this group do?

- Attempt to solve materials problems using new carbon materials AND/OR Increase understanding of processing – properties – structure
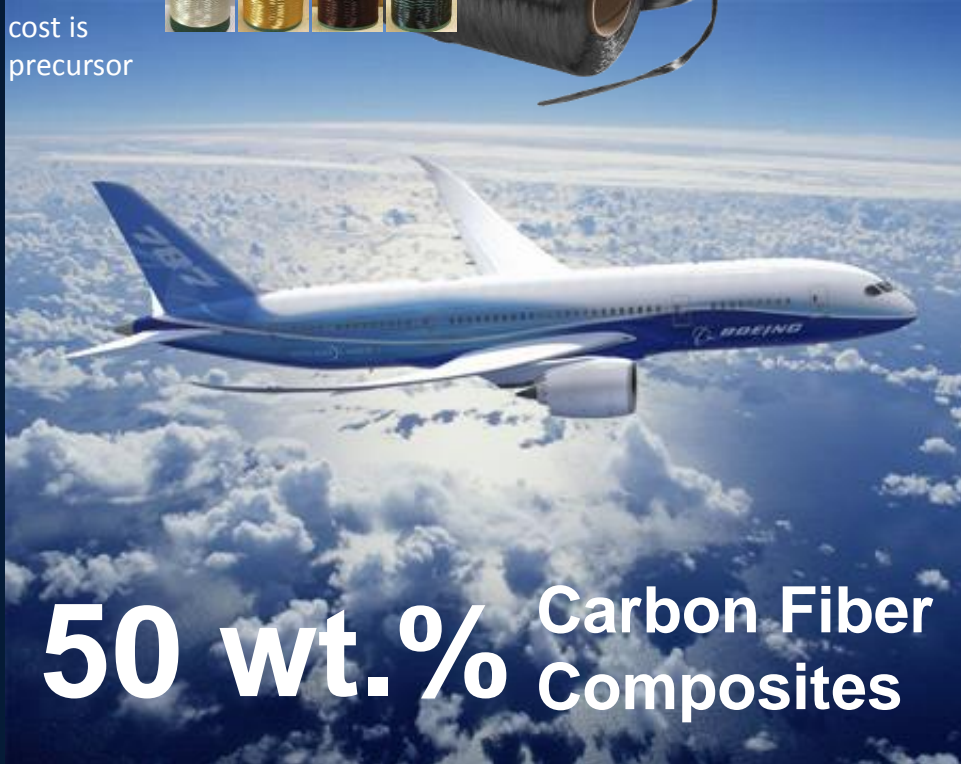
  - Strength – Weight?
    - Strength – Structure & processing
  - Hot Spots?
    - Directional thermal conductivity
  - Waste Heat Energy?
    - Thermoelectric coatings

Ongoing projects: Carbon Fiber

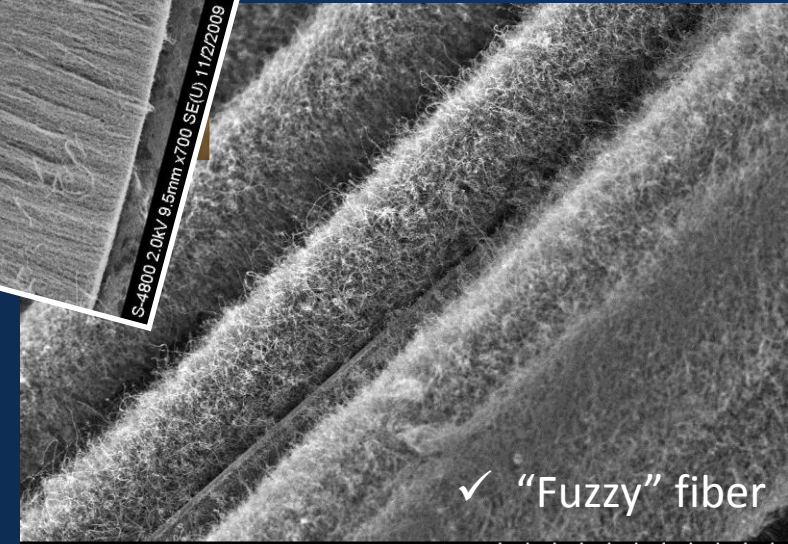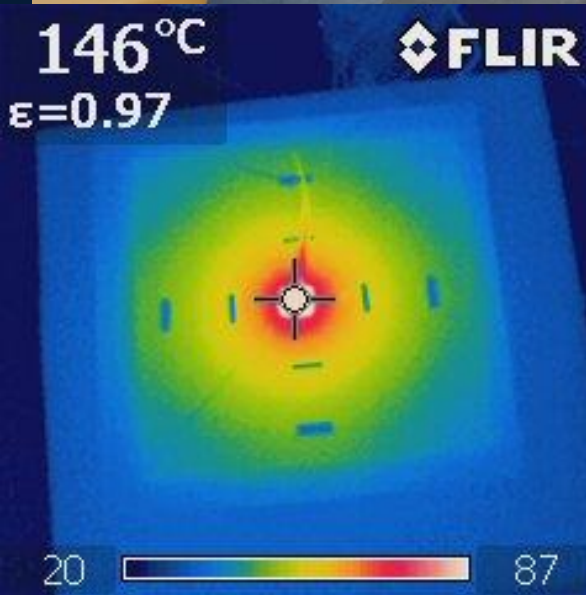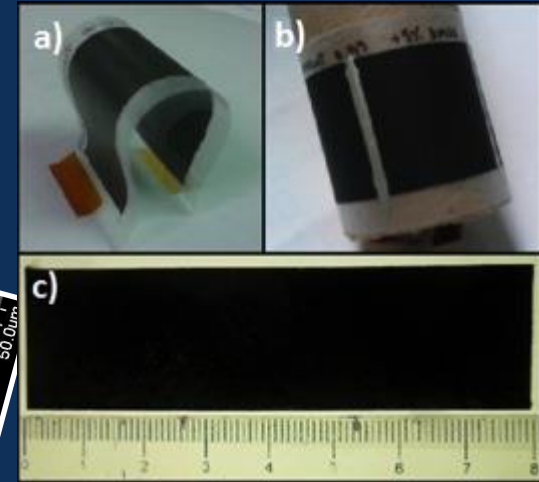50% of carbon fiber cost is precursor

50 wt.% Carbon Fiber Composites
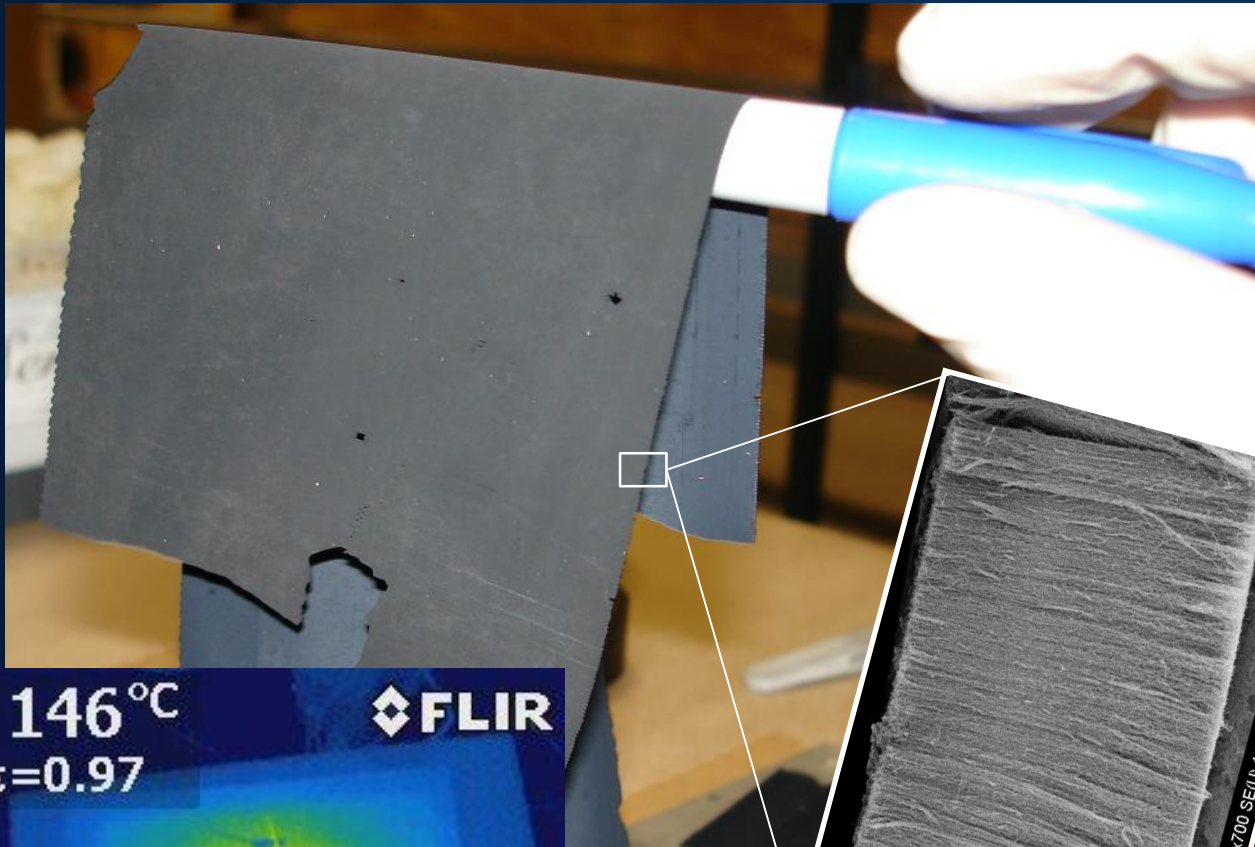
117 MPGe

Lightweight, Safe, Strong, Corrosion Resistant… but $$$$

Ongoing projects: Carbon Nanotubes

- ✓ Thermal Interface Materials
- ✓ Thermoelectric devices

146°C
ε=0.97
◆FLIR
20   87

S-4800 2.0kV 9.5mm x700 SE(U) 11/2/2009   50.0um

a)   b)
c)

✓ "Fuzzy" fiber

S-4800 5.0kV 5.5mm x1.50k SE(U)   30.0um

What skills and expertise can you acquire?

- **Materials Engineering**

  Fiber
  - Polymer processing
  - Heat treatment
  - Materials characterization

  Nanotubes
  - Experimental design
  - Materials characterization
  - Thermal analyses

- **Chemistry**

  Fiber
  - Composition
  - Conversion
  - Reactions

  Nanotubes
  - Synthesis
  - Catalyst development
  - Doping development

- **Mechanical Engineering**

  Fiber
  - Process design
  - Process control
  - Materials mechanics

  Nanotubes
  - Thermal analyses
  - Equipment design
  - Experimental design

- **Chemical Engineering**

  Fiber
  - Process design
  - Process control
  - Fluid dynamics

  Nanotubes
  - Equipment design
  - Equipment modifications
  - Materials characterization

Additional info

- **Where does the carbon materials group get funding from?**

  U.S. Department of Defense   *U.S. Department of Energy*

  KY Dept. of Energy Development & Independence   *Industry Collaborations*

- **Where does the carbon materials group publish?**

  CARBON   Advanced Materials   J. Nanoscience and Nanotechnology
  POLYMER   FIBERS   Composites Science & Technology

- **Where does the carbon materials group present its results?**

  SAMPE: Society for the Advancement of Material and Process Engineering   CARBON conferences   MRS: Materials Research Society   NATAS: North American Thermal Analysis Society

- **Where do students that work in the carbon materials group go afterwards?**

  Industry (e.g. Intel, Cummins, Cytec, Michelin, Bolt Threads)   Government (e.g. DoD, National Labs)   Graduate or Professional School   Academia (e.g. Univ. de Alicante)