

An Overview of the Carbon Materials Technology Group

Dr. Tim Burchell

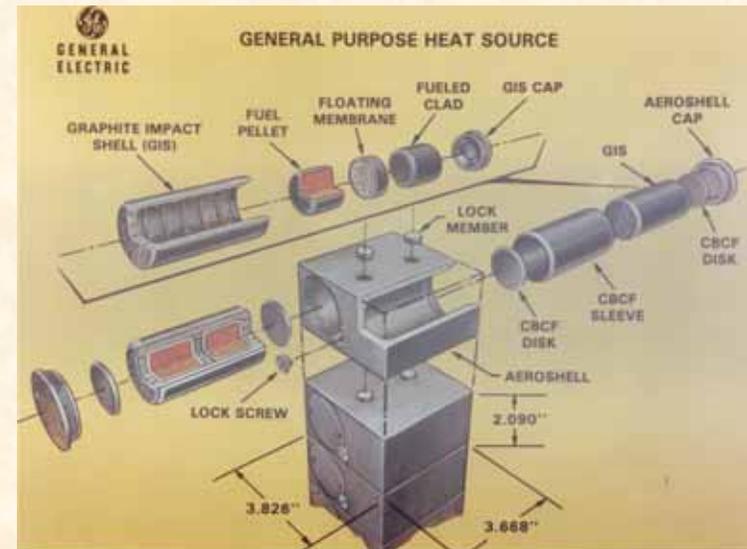
**Leader, Carbon Materials Technology Group
Materials Science & Technology Division**

August 3rd 2006

MATERIALS FOR SPACE POWER

Team Members: Glenn Romanoski, Marie Williams, Paul Menchhofer, Ashli Clark

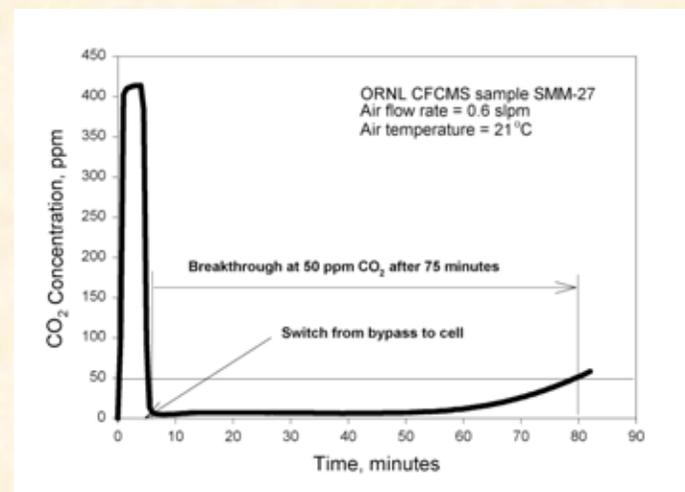
- **Carbon-Bonded Carbon Fiber (CBCF)**
 - DOE Funding in FY'03 = \$370K; FY'04 = \$400K. Additional funding from NASA is anticipated in the near term for a production campaign.
- **JIMO:**
 - Supporting efforts to reestablish a commercial supply of Reactor Grade Nb-1Zr and Re tubing for future Space Fission Reactor (Zinkle)
- **HAPL Project:**
 - Exploring several approaches for cladding tungsten on low activation steels for a DOD fusion device.
 - Funding in FY'03 = \$100K. Follow on funding is anticipated in FY'04
- **Material Replacement for the General Purpose Heat Source:** Chairing committee to recommend a replacement carbon-carbon composite for the General Purpose Heat Source. DOE Funding in FY'04 = \$50K
- **CREARE/NASA THERMAL PHOTOVOLTAIC.**
 - ORNL will support CREARE Inc. in this work for others effort by providing materials data and design evaluation for a proposed TPV converter. Funding over next three years (FY'04-FY'06): \$354K



Gas Separation - Development of Activated Carbon Composites

Team Members: Fred Baker, Tim Burchell, and Cristian Contescu

- Fossil Energy – Advanced Research Materials
- Since FY 1994
- Achievement:
 - Developed carbon fiber composite molecular sieve (CFCMS), a monolith
 - CFCMS adsorbs CO₂ from mixture completely until breakthrough
 - Adsorbs CO₂ from low (~400 ppm) in air to very high 100%
 - CFCMS is highly conductive led to development of electric swing adsorption (ESA)
 - Brought in CRADA and WFO for CO₂ separation/sequestration
 - Currently modifying CFCMS to separate N₂ from O₂ in air
 - Interest in CFCMS for Chemical Weapons Defense



OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

UT-BATTELLE

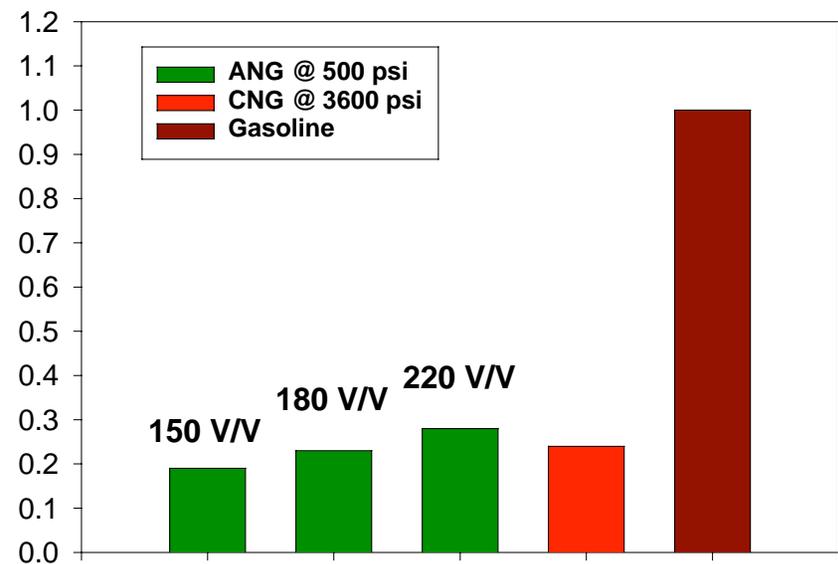
Carbons for Methane Storage

Team Members: Fred Baker, Cristian Contescu, Jane Howe, Nidia Gallego, Mike Rogers, Ashli Clark

Goal-to develop novel methane storage carbons that meet the DOE goal of 150 V/V at 500 psi and 180 V/V at 900 psi.

- Sponsor: DOE Office of Heavy vehicle Technologies (Dr. Syd Diamond)
- Program Manager-Phil Sklad

Energy Densities of Natural Gas Normalized to Gasoline

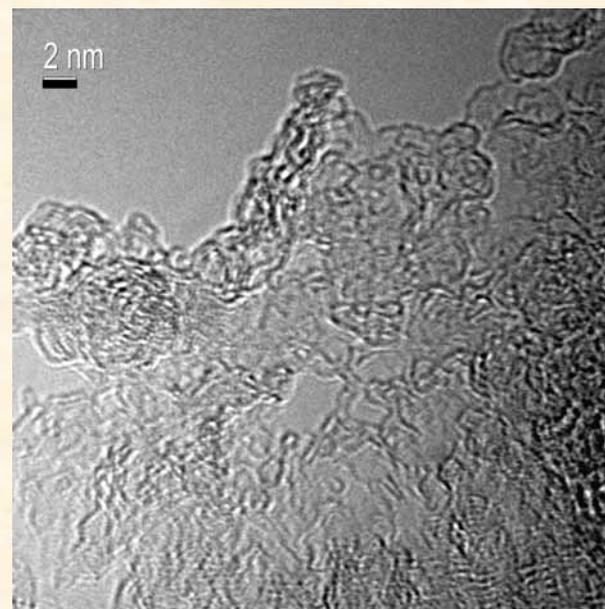
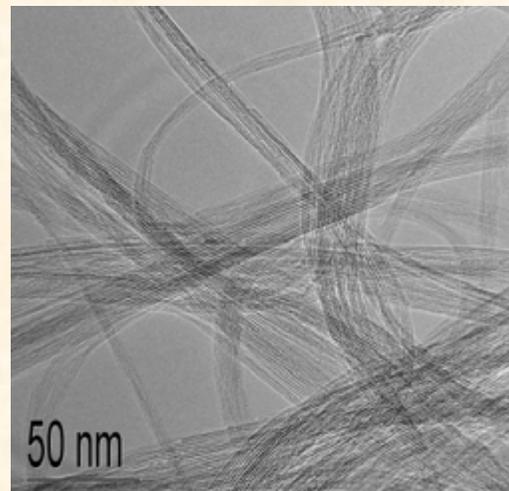


Advanced Characterization

Team Members: Jane Howe, Tim Burchell, Paul Menchhofer

[Support activity for several projects in the CMT Group]

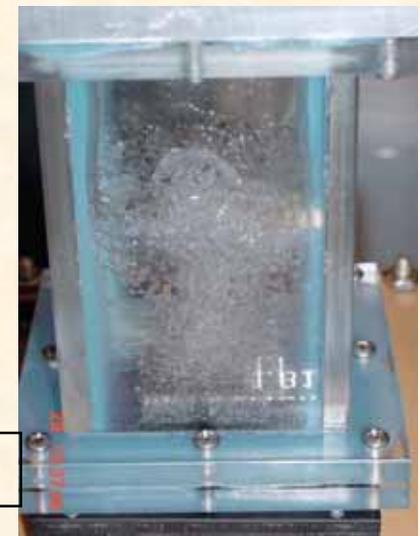
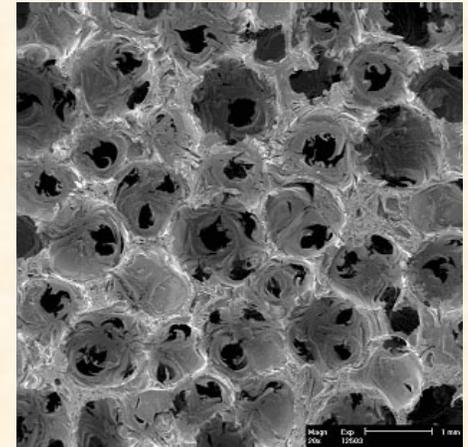
- Characterization of gas storage carbon monoliths using TEM, SANS and SAXS
- Characterization of nanostructured carbon using TEM, SANS and SAXS
- Total diffraction scattering of hydrides and carbons using TOF neutron scattering
- Characterization of Nanostructured Polymer Materials for Biological and Electronic Applications
- Characterization of Catalyst materials for automobile applications



High Thermal Conductivity Carbon Foams

Team Members: James Klett, Nidia Gallego, Glenn Romanoski, Lynn Klett*, Beth Armstrong*, Ron Ott*, Mike Trammel, Claudia Walls

- **DOE EERE**
 - Power Electronics (since '98)
 - \$ 300K ↑
 - FASTER (since '03)
 - Fuel Cell Humidification (since '01)
 - Microturbines (since '01)
 - **NAVY ONR**
 - **Missile Defense Agency**
Phased Array Radar Cooling (since '02)
 - **NAVAIR**
Personal Cooling for Pilots (since '02) \$ 250K;
- **Work for Others**
 - Private companies (since '99)

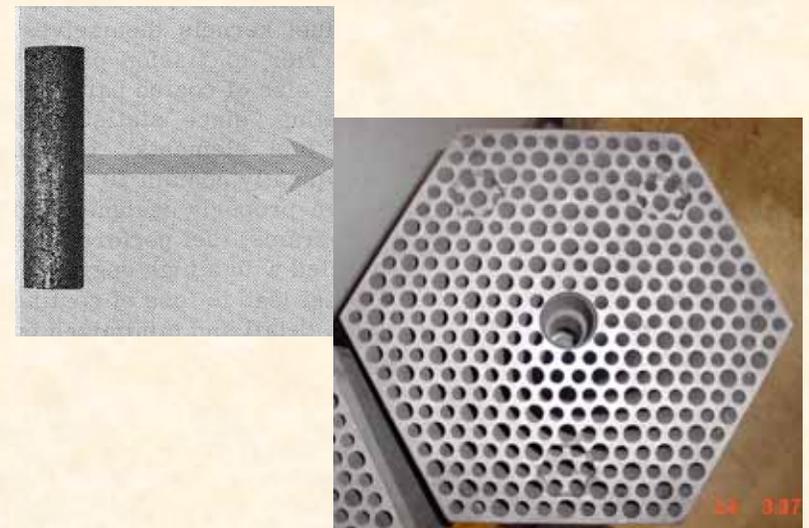
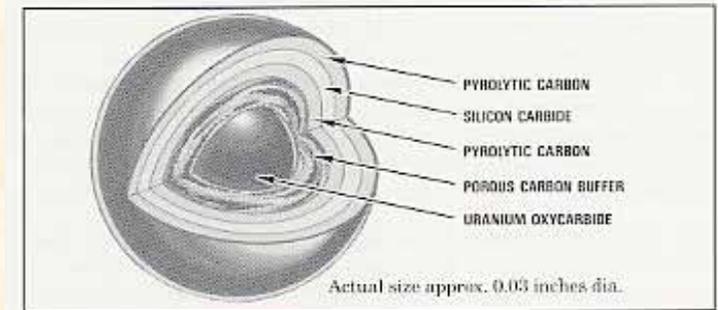


Chip cooler at 150 W/cm²

Advanced Gas Reactor Fuel Compact Development

Team Members: Pete Pappano, Tim Burchell, Fred Montgomery, Mike Rogers, Mike Trammel

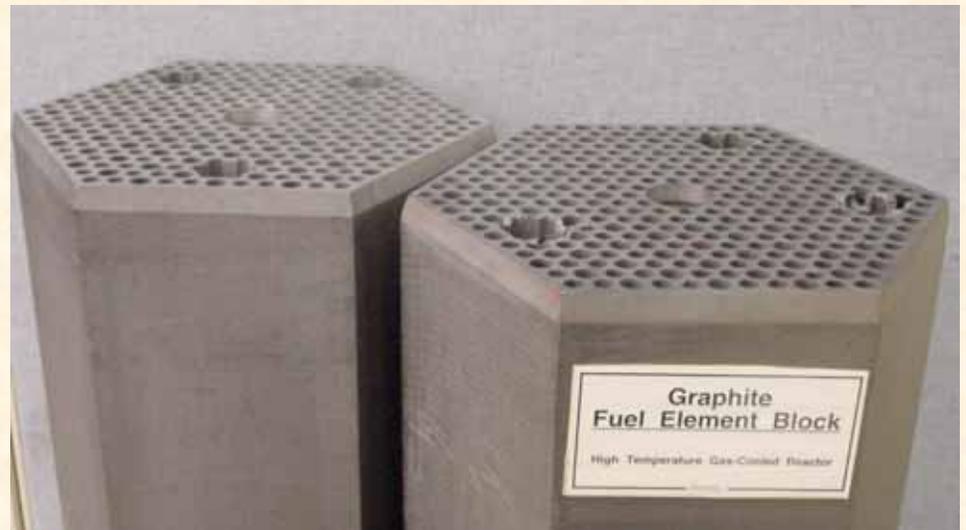
- Sponsor: DOE Office of Nuclear Energy, AGR Fuel Program
- Program Manager-Gary Bell
- Goal: Production of fuel compacts for the Very High Temperature Reactor (VHTR)
- Project duration: FY03 - FY09



Reactor Materials

Team members: Tim Burchell, Pete Pappano, Nidia Gallego, James Klett, Lance Snead

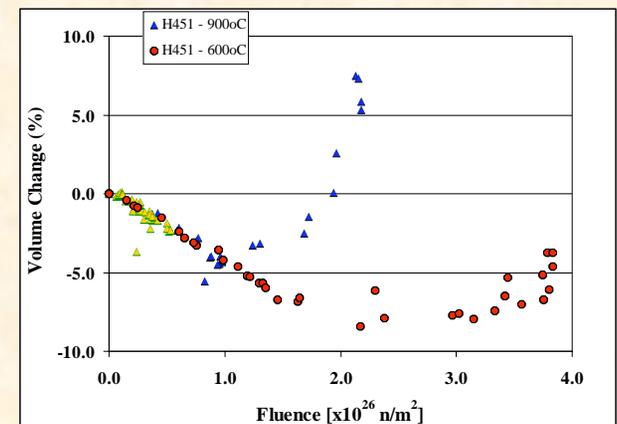
- Gen-IV Materials: Development of graphite design database in support of NGNP design and licensing activities
- NGNP Structural Composites: Development of candidate materials for NGNP reactor core.
- Large irradiation effects program
- Sponsor: DOE Office of Nuclear Energy, NGNP Program
- Program Manager: Bill Corwin



Nuclear Graphite - Graphite Design Codes, Standards and Properties

Team Members: Tim Burchell, Nidia Gallego, Joe Strizak, Pete Pappano

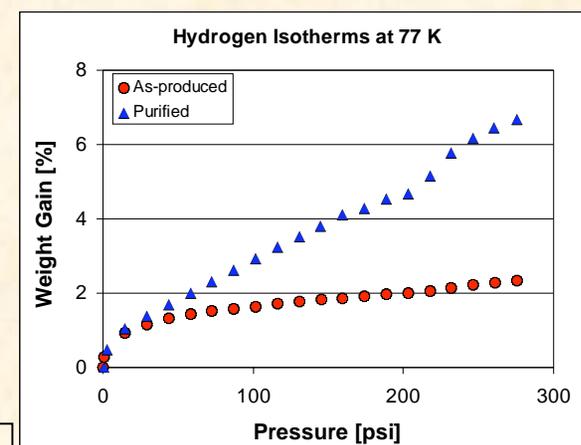
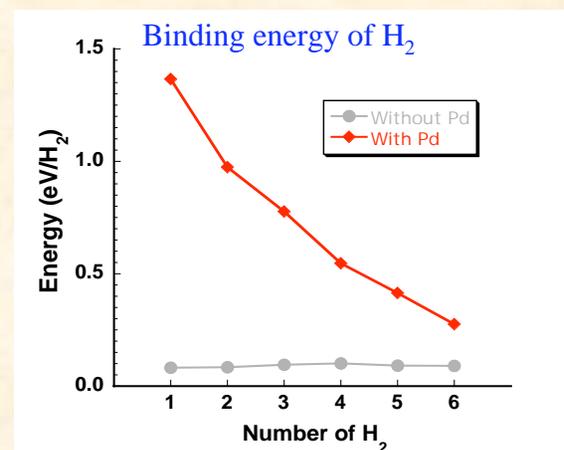
- To evaluate currently available design practices and identify needs and technical issues related to design codes and standards.
- To review and evaluate any available correlations between non-irradiated graphite properties and important irradiated properties.
- To participate in the ASTM nuclear grade graphite standards & ASME Code development.
- Funded by DOE



Materials Science of Nanostructured Carbon and Graphite (LDRD)

Team Members: Tim Burchell, Chong Long Fu, Nidia Gallego, Fred Baker, Cristian Contescu, Jane Howe, Mike Miller, Andrew Kercher, Dave Geohegan*, Bill Shelton**, Bryan Hathorn**

- Characterize nanostructured carbons, develop structural models, simulate gas adsorption and interactions with the carbon surface based on observed carbon structure at the nanoscale using reverse Monte Carlo simulations
- Major BES Program started in FY 05 to explore the role of metal catalysts in the hydrogen adsorption/storage process



OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

H₂ Isotherms for As-grown and Purified SWNTs at 77K

UT-BATTELLE