Industrial Research at National User Facilities

A DuPont Perspective

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NUFO Meeting on Access to National User Facilities

Argonne National Laboratory

The miracles of science™

My Background

Academic training:

- Ph.D. Columbia University (physical chemistry)
- Post-doctoral fellow, University of California, Berkeley (infrared astronomy)

Member of research staff at DuPont for 24 years

- Various research projects
  - X-ray imaging, high temperature superconductivity, photoresists for lithography, soft magnetic composites
  - Currently working on polymer nanocomposites
  - Many projects benefited from neutron or x-ray techniques

20 year involvement with x-ray and neutron science

Currently chair of executive committee of SNS-HFIR User Group at Oak Ridge National Laboratory

Techniques and Facilities Used by DuPont Staff

Diffraction

- Neutron and x-ray
- Diffuse scattering

Small angle scattering

- Neutron and x-ray

Inelastic neutron scattering

- Triple axis
- Time of flight

Analytical

- Neutron activation analysis
- Prompt gamma activation analysis
- X-ray fluorescence

Other

- Pair distribution function
- XAFS/XANES

X-Ray Sources

- National Synchrotron Light Source (Brookhaven)
- Advanced Photon Source (Argonne)
- Stanford Synchrotron Radiation Laboratory
- European Synchrotron Radiation Facility (ILL)

Neutron Sources

- HFBR (Brookhaven)
- NCNR (NIST)
- HFIR (Oak Ridge)
- IPNS (Argonne)
- ISIS (Rutherford Appleton Laboratory)
- LANSCE (Los Alamos)

DuPont Materials Research at National Facilities

Inorganic materials

- High temperature superconductors
- Transition metal oxides
- Metal oxides (catalysts)
- Zeolites
- Magnetic materials (Fe)
- Nanoparticles
- Engineering materials

Organic materials

- Polymers
- Polymer composites and nanocomposites
- Small molecules

Specific Examples

NAA Analysis of Transition Metal Impurities in TiO_2

- NIST

Structure-property relationships in transition metal oxides

- NSLS, NIST, ISIS, APS

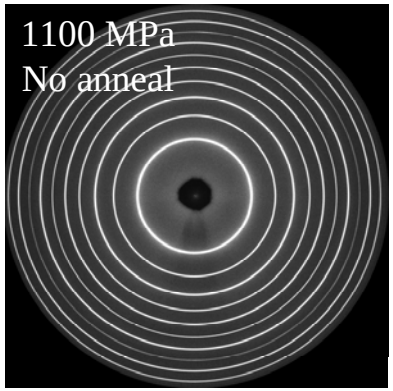
Real-time SAXS/WAXS under stress

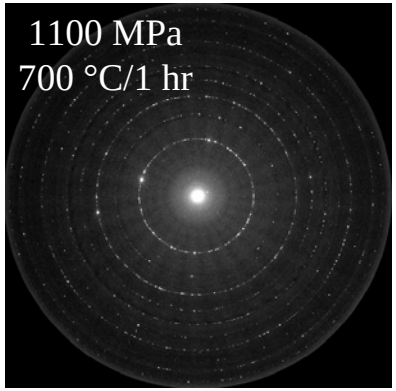
- DND-CAT at APS
- Analyze failure mechanisms in polymer nanocomposites
- Observe stress transfer to filler particles

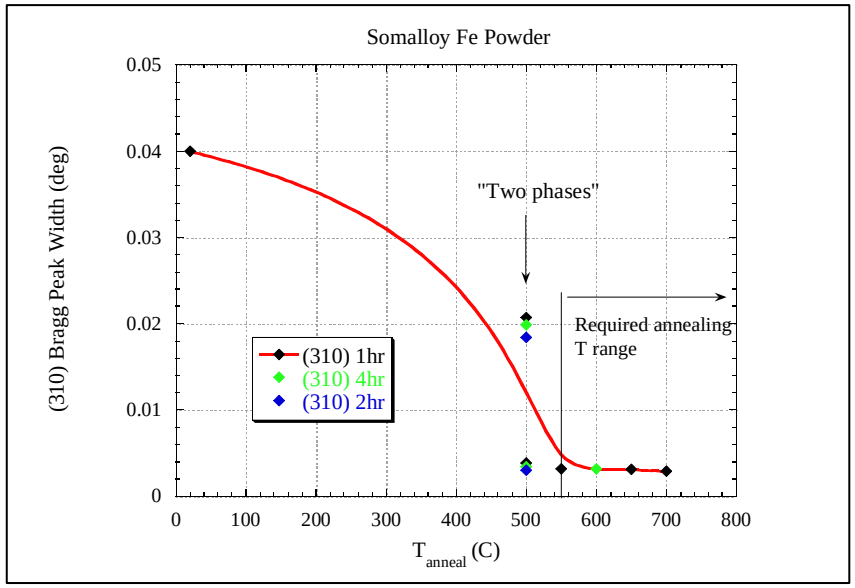
XRD Analysis of Strain Relief in Soft Magnetic Composites

- APS

XRD Analysis of Strain Relief and Recrystallization in Fe Soft Magnetic Composites







Data collected at DND-CAT (APS)

Fe composites undergo high pressure compaction

- Introduces lattice strain in Fe particles which degrades magnetic properties
- Annealing at high temperature relieves strain
- How high must temperature be?

Synchrotron data provided verification of customer's process conditions

- Needed to establish stability requirements for all materials used in composite
- Very short wavelength x-rays used to increase penetration length
- This data was not specified as proprietary and did not directly lead to an invention
- Will be published (but after a delay)

Modes of Access Used For DuPont Research

Proposals

- NIST, ISIS, APS, ISIS
- Non-proprietary research intended for publication

Collaborative

- HFBR, HFIR
- Non-proprietary research intended for publication

PRT (Principal Research Team)

- NSLS

CAT (Collaborative Access Team)

- APS (DND-CAT)

Proprietary time

- APS

Characteristics of Industrial Research Today

At the level of the individual researcher

- Member of multidisciplinary research team
- Often little scientific continuity from program to program
- Short time available to learn new techniques
- Working on multiple projects simultaneously is common

At the corporate level

- Few companies can maintain large, scientifically diverse research staffs
  - X-ray and neutron science experts may not be available in-house
  - Smaller companies even less likely to have experts in multiple areas
- ***Open innovation*** is an important aspect of modern corporate research efforts
  - Obtain technologies and expertise from sources outside the company
  - National facilities fit very well in this model

Industrial researchers need to connect with experts at national labs or universities

Issues and Suggestions

In-house expertise is often not available in industry

- Industrial researchers may not even be aware that relevant techniques and capabilities exist

Access via CAT or PRT

- Each sector or beam line only has certain techniques available
- Research needs evolve and may require new experimental techniques beyond those available in one CAT or PRT

National facilities have the expertise

- Increase industrial outreach efforts
- Central clearinghouse for industrial users to connect with the right experts
- Provide services to collect routine data (e.g. powder diffraction)
  - This already exists in some instances

Expanded CAT or PRT

- More than one sector at APS
- More than one facility at Argonne
- More than one laboratory
  - APS at Argonne
  - SNS at Oak Ridge

Issues and Suggestions

Standard access via proposals

- 6 month proposal periods
- Beam time allocated based upon scientific merit of proposal
  - Industrial proposals may not compete effectively based upon science

The value of academic research

- Publications
  - Number
  - Impact
- Education of students
- Patents

Industrial access via proposals

- Separate proposal track for industry with shorter period (e.g. 3 month)
  - Industrial research review panel
- Beam time allocated based upon
  - Scientific merit
  - Potential economic benefit

The value of industrial research

- Economic impact
  - New or improved products
  - Patents
- Publications
- Employment of scientists

How do we compare the value of different types or research?

Issues and Suggestions

Proprietary or non-proprietary research?

- It is not always obvious before hand if intended research will lead to results that should be classified as proprietary

Provide the option to retroactively declare beam time as proprietary

- Provide a buffer time period during which industrial users can decide if data is important for a patent application, or should be protected as a “trade secret”
  - If yes, pay proprietary charges for that beam time
  - May require non-disclosure agreements
  - Provides more flexibility when planning experiments

Current Economic Issues

Many companies have significantly reduced external spending to help offset poor economic conditions

- Auto
- Chemical
- Electronics
- Pharmaceutical

Can the national user facilities develop research programs with industrial users that further the national agenda in areas such as alternative energy?

- Non-proprietary or proprietary research
- Collaborative research programs (similar to CRADAs)
- Build upon combined strengths of industrial and national facility partners

Conclusions

Industrial research has unique characteristics

- More applied than academic research
- Today primarily driven by business needs rather than science
- Economic benefits to corporations, shareholders and society
- Projects often short-term (< one year)
- ***Fast identification and implementation of techniques is essential***

Multiple means of access are useful

- CAT/PRT models provide good compromise between research flexibility and access speed, but require significant investment
  - Increase breadth of techniques available in this model
- Standard proposals fine for basic research needs
- Designation of proprietary beam time works, but perhaps could be more flexible

In current economy additional incentives will help attract industrial users

- Provide experts who can assess needs and recommend course of action
- Highlight industrial applications of neutron and x-ray science in various forums
- Develop new forms of collaboration between national labs and industry

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