APS Cross-Cut Reviews

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Purpose of the Cross-Cut Reviews

- **Science Advisory Committee does sector-by-sector reviews**
- **Cross-cut gives an important perspective**
  - focus of review is retrospective (“where are we now”)
  - additional experts invited
- **Report will advise APS on strengths and opportunities**
- **Session is open for healthy information exchange**

2004 Cross-Cut Review: Science with Microbeams

- Current research programs involving x-rays focused to < 10 microns
- Asked sectors for their best science
- Only one presentation per sector, due to time (Sectors included based on scale of activity.)
- External experts brought in to help us evaluate the work being done here

"Such a review can also help to **develop more integration of research activities at APS**, creating science/technique-oriented synergy among all of the different users. In addition, it will **open the dialogue to initiate and drive coordinated efforts in technical R&D**, e.g. for software/real-time data analysis, detector developments, real-time instrument controls, and efficient user interfaces. It could also help to make the best out of the present situation at APS with various methods and similar experiments scattered around the ring." ***The Review Committee.***

Great Science

- Three dimensional polychromatic microdiffracion studies of mesoscale structure and dynamics; *Gene Ice (Sector 34)*
  - *Summing up, **this is probably one of the best if not the best K-B mirror based microprobe** and it is a very impressive development of the technique to map out the strain tensor in grains of polycrystalline materials.*

- Applications of x-ray microbeams at the PNC-CAT Beamlines; *Steve Heald (Sector 20)*
  - *These studies have provided fundamental information on biogeochemical reactions controlling U mobility in the environment. They have also been **extremely influential in establishing waste policy decisions at Hanford** and in demonstrating how uranium fate can be characterized via XAS methods.*

- High-pressure Geoscience at GSECARS (Sector 13); *Guoyin Shen (Sector 13)*
  - *The **GSECARS team has developed what is widely recognized as the world's best system** combining state-of-the-art laser heating and microbeam X-ray techniques for applying the DAC to geologically important problems.*

More Great Science

- Strain effects in thin film/Si substrates revealed by x-ray microdiffraction; *Cev Noyan (Sector 2)*
  - *It provides an **excellent example of research of technological importance to an important U.S. industry** that also advances our fundamental scientific understanding of important materials phenomena as well as our understanding of the underlying diffraction process and its theoretical description. To emphasize: this was a great presentation with beautiful results.*

- Intracellular manipulation by TiO_2; *Gayle Woloschak (Sector 2)*
  - *This project has **all the hallmarks of what a cross-cutting project should have**: it is truly interdisciplinary with important contributions from the materials sciences (nanocomposites), biology (DNA/molecular genetics), physics (charge pair separation), chemistry (binding of carboxyl groups to TiO_2), biomedical applications (disease therapies, environmental studies), and not the least – potential state-of-the-art use of synchrotron beamlines (hard x-ray microprobe imaging and microspectral analysis).*

Areas for Improvement

- Most of the microbeams at the APS are formed with K-B mirrors. These have the advantage that they are achromatic. The best of the K-B mirrors have demonstrated focal spot sizes in the sub-100 nm range. In routine use at the APS, they are often used with a focal spot size of 2-10 microns, and in only a few cases in the sub-micron regime. When the larger spot size is designed to capture more flux or to create a more parallel beam, then this is clearly justified. **However, in some of the presentations stability, difficulty of alignment, and vibrations were mentioned as reasons for relatively poor performance.**

- **Some of the instruments are not optimized for maximum throughput.** The problem tends to be either the frequent change of apparatus requiring time-consuming alignment or the lack of optimized software for data acquisition.

- Overall, the **APS microscopy programs seem to be missing some cutting-edge developments, such as coherent imaging techniques**. The APS needs to first of all attain world leadership in straightforward microprobe applications, but other methods should be pushed as well.

Comments on the Cross-Cut Review Process

- The majority of presenters described their own work, without providing any wider context such as the relationship of their work to that at other APS sectors or at other national and international facilities.

- In addition, the talks were not structured in a way that would allow the panel to judge the quality of the APS instrumentation and facilities for carrying out excellent science.

Science Using the Pulsed Structure of the APS X-ray Beams

Jim Norris (U of C), Chairman

- *It will be held on January 26, 2005 as part of the annual Scientific Advisory Committee (SAC) Meeting.*
- *A request will go out to CAT Directors/Sector Managers requesting them to identify the specific research programs at their sectors that fit into this category by October 30.*
- *We also need the names of potential speakers by October 30 so that a tentative agenda can be developed.*