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SHARED RESEARCH EQUIPMENT AT OAK RIDGE NATIONAL LABORATORY

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The Shared Research Equipment (SHaRE) User Facility and Program at Oak Ridge National Laboratory (ORNL) provides microanalytical facilities for studies within the materials sciences. Available instrumentation includes advanced analytical electron microscopes, atom probe field ion microscopes, and nanoindentation facilities. Through SHaRE, researchers from U.S. universities, industries, and government laboratories may collaborate with Facility scientists to perform research not possible at their home institutions. International collaborations are also possible. Most SHaRE projects seek correlations at the microscopic or atomic scale between structure and properties in a wide range of metallic, ceramic, and other structural materials. Typical research projects include studies of magnetic materials, advanced alloys, catalysts, semiconductor device materials, high T_c superconductors, and surface-modified polymers. Projects usually involve one or more external researchers visiting the SHaRE Facility for up to three weeks during the fiscal year (October 1 - September 30). Project approval is based upon the scientific excellence and relevance of proposed collaborative research. Operating time is available without charge to researchers who intend to publish their results in the open literature. Additionally, proprietary research can be accomplished on either a full cost-recovery basis or by Cooperative Research and Development Agreements (CRADAs). Analytical services (service microscopy) which can be purchased from commercial laboratories are not offered by SHaRE. Detailed information regarding the SHaRE User Facility, available instrumentation, travel support, faculty fellowships, and how users access these is available at http://www.ornl.gov/share.

Central to the user facility are state-of-the-art research instruments. Several advanced analytical electron microscopes are available with capabilities including light element energy dispersive X-ray spectrometry (EDS), electron energy-loss spectrometry (EELS), convergent beam electron diffraction (CBED), and scanning transmission electron microscopy (STEM). A 200 kV Schottky field-emission gun (FEG) AEM is equipped for EDS, EELS, STEM, CBED, spectrum imaging, and digital image acquisition. Compositional analysis with a probe diameter down to ~1 nm, or high-resolution imaging with a 0.15 nm information limit is possible. A 300 kV AEM is available and provides greater penetration and less beam broadening, while providing high resolution electron microscopy capabilities with lattice and structural imaging to ~0.2 nm. Additionally, this microscope is equipped for energy-filtered transmission electron microscopy (EFTEM). A 'workhorse' 120 kV AEM is used for conventional microscopy experiments such as defect analysis, selected area or convergent beam electron diffraction, hollow cone illumination, and light element EDS. Real-time video imaging and recording is available for *in situ* experiments. Furthermore, various specimen holders enable experiments to be conducted over a wide range of temperature, orientation, or stress state. The SHaRE Facility includes a fully analytical Schottky-FEG scanning electron microscope. The SEM is configured for secondary or backscattered electron imaging, light element EDS, wave-length dispersive X-ray spectrometry, orientation imaging microscopy, and real-time signal mixing and display. The accelerating voltage is continuously variable between 0.2 and 30 kV. Additionally, the SEM is equipped with an oil-free vacuum system, motorized eucentric specimen stage, and digital image acquisition and storage.

The atom probe field ion microscopy (APFIM) facility includes two energy-compensated atom probes (ECAP) and a three-dimensional energy-compensated optical position-sensitive atom probe (ECOPOSAP). The energy-compensated time-of-flight mass spectrometers on these atoms probes offer the highest available mass resolution and can resolve individual isotopes of all elements. These microanalytical instruments permit the atomic level characterization of ultrafine scale (< 1nm) compositional variations due to precipitation and interfacial segregation, etc. Facilities are also available

to examine APFIM specimens in the transmission electron microscopes. Sophisticated statistical analysis and data visualization software is available for the analysis of data from the ECAPs and the three-dimensional ECOPOSAP.

Both elastic and plastic mechanical properties can be characterized at high spatial resolution from load-displacement data generated by either of SHaRE's two mechanical properties microprobes. Using programmed loading sequences from 0.05 to 300 mN, indentations as small as a few nanometers can be routinely made.

Materials scientists external to ORNL can access the SHaRE User Facility and collaborate with internal research staff by participating in the SHaRE Program. The SHaRE Program is jointly administered for DOE by ORNL and the Oak Ridge Institute for Science and Education (ORISE). Proposals for both new and renewal projects are submitted using a form which is available upon request, or downloaded from the SHaRE web site. These briefly describe the proposed collaborative research and are submitted for review and approval by the SHaRE Executive Committee. Proposed research projects must be approved before participation is possible. Approval is based upon scientific excellence of the proposal, relevance to DOE goals, and when applicable, the previous SHaRE-sponsored research record of the proposers. Two types of research projects are supported under SHaRE. Exploratory research projects are permitted to test the feasibility of a research idea. Such research is short term and can require the direct assistance (equipment operation) of an internal ORNL staff member. Often, successful completion of an exploratory research project leads to extended collaborative research. Extended collaborative research requires the continued participation of the internal staff members. Here, after appropriate training, the external participants become more active in the experiments and long-term research goals are set. While project proposals may be submitted at any time during the fiscal year, researchers are especially encouraged to submit proposals during September for review during the Executive Committee meeting in October. All SHaRE projects are reviewed annually.

Travel support under the SHaRE Program is available to help defray program-related travel and subsistence expenses incurred by academic participants. Travel support under this program is limited to principal investigators (faculty or post-docs) from U.S. accredited universities and their graduate students. Others may submit proposals for facility use without travel support. Requests for travel support are made within SHaRE proposals. Additional information on travel support and policies may be obtained within SHaRE's web site, in the 'Handbook' section.

SHaRE Faculty Fellowships have been established to provide outstanding university faculty extended access to the SHaRE User Facility for a period of intense research and collaboration. The duration of each fellowship is usually between six and twelve weeks. Annually, at least one junior and one senior university faculty members are awarded fellowships. Fellowships are usually taken during the participant's summer semester or quarter terms, but this is not a requirement for participation. Applicants must be full-time permanent faculty members at accredited U.S. colleges or universities. Stipends paid to fellows are based upon, but may not exceed, their regular college/university salary. Additionally, the costs of travel for one round-trip between the academic institution and ORNL may be reimbursed. Travel reimbursements and fellowship stipends are made according to ORISE standard policies.[1]

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