

Long-Distance Real-Time Collaboration for Materials Micro-characterization

M.A. O'Keefe⁺, E. Voelkl^{*}, K.B. Alexander^{*}, J.C. Mabon[#], M.T. Postek^{*}, M.C. Wright[†] and N.J. Zaluzec[‡]

⁺National Center for Electron Microscopy, University of California, LBNL B72, Berkeley, CA 94720

^{*}Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831

[#]Materials Research Laboratory-CMM, University of Illinois, Urbana-Champaign

[•]Precision Engineering Division, National Institute of Standards & Technology, Gaithersburg, MD 20899

[†]Instrumentation and Controls Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831

[‡]Materials Science Division, Argonne National Laboratory, Argonne, IL 60440

The Materials Microcharacterization Collaboratory (a DOE-2000 pilot project) combines four DOE laboratories (at ANL, LBNL, ORNL, and UIUC) and the DOC NanoMetrology Lab at NIST into one networked collaboratory with expertise and instrumentation (primarily electron microscopes) available to the entire U.S. (and world-wide) materials science community on-line. Work is proceeding to make additional facilities available in the near future (see the MMC home page at <http://tpm.amc.anl.gov/MMC/HomePage.htm>) for full information).

Background - The DOE Materials Microcharacterization Collaboratory (MMC) was created in March 1997 as a pilot project within the US Department of Energy's DOE2000 program. DOE2000 has, as its main goals, to develop improved capabilities for solving DOE's complex scientific problems, to increase DOE's R&D productivity and efficiency, and to enhance the access of R&D partners to DOE resources. One strategy to meet the goals of DOE2000 is the establishment of national collaboratories to provide access via the Internet to unique or expensive DOE research facilities and to expertise for remote collaboration, experimentation, production, software development, modeling, and measurement. Cooperative pilot projects are expected to lead to significant scientific achievements by developing new capabilities and increasing the efficiency of doing the work (e.g., by reducing travel, increasing communication, and promoting the sharing of data among formerly disparate research groups). The MMC [1] unites four DOE BES electron

microscopy user centers located at ANL, LBNL, ORNL and the University of Illinois with the DOE EE center located at ORNL. Also included in the MMC project is the NAMT program of NIST, and neutron and x-ray beam lines at ORNL and BNL.

Accomplishment - Remote computer control of electron microscopes is a cornerstone of the MMC, and several MMC partners have contributed interfaces to make microscopes accessible remotely [2,3,4]. A common MMC remote-user interface is currently under development. At the moment, users may access the NCEM high-voltage 1.5MeV Kratos EM-1500 for remote in-situ microscopy using a Motif-based interface that includes local automatic compensation for stage drift (caused, for example, by remotely-controlled specimen heating). For high-resolution microscopy, users have access to an ORNL 200keV Hitachi HF2000 or an NCEM 300keV Philips CM300. Respectively, these high-resolution interfaces use Digital Micrograph with Tim-

buktu (HF2000) and an LBNL-developed Java GUI (CM300) to allow the remote user to control the microscopes. The ANL dedicated STEM VG HB603 is available to remote users via a web-based interactive interface.

In addition to making tools available for the practice of materials research, MMMC's projects are designed to extend, improve and mold the laboratory environments already in place at each of our Centers into a single cohesive vir-

tual laboratory, accessible from anywhere on the Internet. We will use the extended capabilities of the Collaboratory to address materials sciences research problems while continuing to develop a functional, interactive electronic collaboratory having all the necessary tools for operation by the microanalysis community.



For one-to-many transmissions, we have made extensive use of streaming JPEG video in a web browser. The MMC Website home page (<http://tpm.amc.anl.gov/MMC/HomePage.htm>) shows one microscope at each participating laboratory. In collaboratory mode, the Website can show two of the microscopes and the live data streams (images or spectra) from each, enabling collaborators to work together and compare results in real time.

1. Wright M.C. in *56th Ann. Proc. MSA*, Atlanta, GA (1998) and URL = <http://tpm.amc.anl.gov/MMC/>
2. Zaluzec N.J. in *53rd Ann. Proc. MSA*, Kansas City, Missouri (1995) 14-15.
3. Parvin B. *et al.*, in *53rd Ann. Proc. MSA*, Kansas City, Missouri (1995) 82-83.
4. Voelkl E. *et al.*, in *53rd Ann. Proc. MSA*, Kansas City, Missouri (1995) 22-23.