

Description of the EMAL Facilities – 9-Oct-2006

The University of Michigan EMAL is divided into two physically distinct laboratories, which are unified administratively, as described later in this section.

Central Campus Branch – The Central Campus Branch is located in the Department of Geological Sciences' C.C. Little Building and comprises of approximately 3000 square feet of custom-designed space. It provides services to the entire University. Primary users include the College of Pharmacy, the School of Dentistry, the Museum of Zoology and Paleontology, the Departments of Physics, Chemistry, Biology, Geological Sciences and Materials Sciences & Engineering. The principal equipment includes: (1) a Cameca CAMEBAX electron microprobe analyzer (EMPA) with four spectrometers and a Kevex XEDS system; (2) a Cameca SX 100 EMPA with six spectrometers and a Rontec Xflash 2000 XEDS system; (3) a Hitachi S3200-N SEM with a Noran XEDS system; and (4) a Philips CM12 STEM with a Kevex Quantum XEDS system.

The North Campus Branch – The North Campus Branch of EMAL is located in the College of Engineering on the North Campus of the University and provides services to the entire University. It is located in a custom-designed basement wing that provides approximately 4500 square feet of low-vibration, low-field, environment controlled laboratory space. Its primary users are MSE, NERS, ChemE, EECS, Mechanical Engineering, Environmental and Civil Engineering, Chemistry and Physics. The principal equipment includes: (1) a JEOL 2010F FasTEM AEM with an EDAX/Gatan XEDS, Gatan TV cameras and Imaging Filter; (2) a JEOL 3010 HRTEM with an AMT camera system; (3) a Philips/FEI XL30 FEGSEM with EDAX XEDS system; (4) a FEI Nova 200 Nanolab Dualbeam FIB with EDAX XEDS system; (5) a Philips/FEI XL30 ESEM with cryo-stage and EDAX XEDS system; (6) a Kratos Axis Ultra XPS system; (7) a FEI Quanta 3D Dualbeam FIB and environmental SEM; (8) a Digital Instruments (DI) NanoScope IIIa scanning probe microscope (SPM); and (9) a DI NanoScope E SPM with an attached dedicated Hysitron Triboscope indenter system. Both facilities also have equipment for specimen preparation, saws, polishing tables, microtomes and ion mills.

E.3 User Training

The staff of EMAL is responsible for the training of users and advising potential users of the most suitable equipment for their needs. There are two courses, one in Geological Sciences (Mineralogical Techniques of Analysis) and one in MSE (Introduction to Electron Microscopy and Microanalysis), which provide extensive background in the theory and operation of the EMAL equipment. The Geological Sciences course, currently taught by Udo Becker or Rod Ewing, includes sections on TEM, STEM, SEM, electron microprobe analysis, XPS and SPM. Approximately 10-15 students take this course biannually. Xiaoqing Pan currently teaches the MSE course. The course focuses on TEM, STEM, SEM, electron diffraction, and introduces HRTEM, CBED, EDS, EELS, SPM and XPS. Approximately 25 students take this course annually. Both courses feature extensive laboratory components and the students all have hands-on experience on the EMAL instruments.

Since EMAL has in excess of 400 regular users, there are frequent periods, between the formal courses, during which the laboratory staff trains users either on a one-to-one basis or in small groups. The laboratory staff monitors the users' abilities and determines when a user can use the equipment independently without oversight. Staff also aid in specimen preparation, data analysis and interpretation.

E.4 Management Plans

E.4.1 EMAL Administration

EMAL has a well-organized structure and management that allows it to run effectively and efficiently, the details of which are outlined below.

E.4.2 EMAL Executive Committee

The EMAL Executive Committee guides the long-term strategy and development of the laboratory. This committee consists of a Director, Lumin Wang, a professor in NERS, and two Associate Directors, John Mansfield, an associate research scientist in MSE, and also the north campus branch manager, and Eric Essene, a professor in Geological Sciences. There are two other members of the committee, representing the laboratory users, Xiaoqing Pan, a professor in MSE, and Adam Matzger, a professor in Chemistry. The Committee sets access policy, proposes recharge rates and plans the development and direction of the laboratory.

E.4.3 General Management

Carl Henderson, a senior research laboratory specialist is responsible for managing the Central Campus laboratory. He earned his bachelor's degree from Dartmouth College in 1981. He joined the University of Michigan in 1984 and is an expert in electron microprobe analysis. He is a frequent collaborator on a wide array of electron microprobe based publications.

John Mansfield, an associate research scientist, manages the North Campus EMAL. Mansfield has over 25 years experience in the field of electron microscopy and related microanalysis. Mansfield earned his PhD at the University of Bristol in the UK in 1983 under the supervision of John Steeds. His post-doctoral studies took him to Argonne National Laboratory and the Microelectronics Center of North Carolina. Mansfield has managed the North Campus EMAL for nearly twenty years.

Mansfield is assisted by 2 full-time PhD-level scientists. The first, Kai Sun, an assistant research scientist, earned his PhD from Dalian University of Technology, Dalian, China in 1998. The second, Haiping Sun, a research electron microscopist, earned his PhD from the University of Michigan, Ann Arbor, Michigan in 2005. Both have extensive research experience of materials characterization by electron microscopy. Kai Sun's and Haiping Sun's resumes are included in this proposal. All three full-time staff actively collaborate with EMAL users, designing experiments, acquiring and analyzing data. They also, where time permits, have their own research efforts.

E.4.4 Instrument Recharge Rates & Maintenance

The expenses incurred in maintaining EMAL are offset by recharges to the individual investigator's research grants. Currently the instruments are recharged at a rate of \$40 per hour for daytime use and \$30 per hour for nighttime and weekend use. The charges are calculated to cover the operation and maintenance of the laboratory and do not cover the salaries of the staff of the facility. The charges are reviewed and set annually by the U of M Financial Operations (following the guidelines set by the Federal sponsors of the research grants that use the facility). Some of the equipment in EMAL is not maintained on a service contract; the experience and abilities of Henderson, Mansfield, K. Sun and H. Sun are sufficient to maintain the instruments in top working order. However, the JEOL and FEI instruments are especially heavily used and it is imperative that they are available for use virtually continuously. This equipment is maintained on manufacturers' service contracts.

