Facilities and Resources

Microscopy, Imaging and Cytometry Resources (MICR) Core
Kamiar Moin, Ph.D., Director
Jessica Back, Ph.D., Associate Director
313-577-2511
http://micr.med.wayne.edu/

Environment

Overview: MICR is a nationally recognized state-of-the-art imaging facility with established administrative policies located in the School of Medicine at Wayne State University. With a 30-year history, it is the only facility of its kind at Wayne State University. MICR offers state-of-the-art technology for the evaluation of multiple parameters in a single specimen utilizing confocal microscopy, electron microscopy, flow cytometry*, in vivo* animal imaging and related techniques.

Services: Include confocal microscopy, multiphoton microscopy, super-resolution microscopy, conventional light microscopy; FRET and FRAP; in vivo small animal imaging (including SPECT, CT, PET, X-ray, and optical imaging); flow cytometry and ratiometric analyses (e.g., intracellular pH and ion measurement studies), as well as three- and four- dimensional image reconstruction and quantitative measurements; cell sorting; application and study design consultation; training and workshops.

Resources:

Technical Capabilities

- Electron Microscopy, including 3D block face EM, Array Tomography and conventional SEM
- Conventional light and fluorescent microscopy
- Confocal microscopy, including super-resolution
- Multiphoton microscopy
- FRET and FRAP analysis
- High-content imaging
- Flow Cytometry
- Advanced image analysis including 3D and 4D image reconstruction and quantitative analysis
- *In vivo* small animal imaging including Optical, X-ray, PET, SPECT and CT
- *In vivo* large animal PET/CT imaging.

Instrumentation

- Zeiss Gemini-300 Field Emission Scanning Electron Microscope equipped with the following:
    - Gatan 3VIEW Serial Blockface System for 3DEM
    - Atlas 5 Array Tomography
    - ORS Dragonfly Analytical Software and offline workstation
    - Automated Intelligent Imaging
    - Nono VP high pressure imaging system
    - Computer command center.
- Zeiss LSM-510 META Laser Scanning Confocal Microscope with Multiphoton capability equipped with the following:
    - Zeiss Axioplan-2 upright microscope stand
    - 458/477/488/514 nm multiline Argon Laser.
    - 543 nm HeNe Laser.
    - 633 nm HeNe Laser
    - Coherent Chameleon TiSa multiphoton near infrared laser (tunable from 720-950 nm).
    - Fully automated programmable scanning stage.
    - Fully automated motorized lens turret

- Two conventional fluorescent detectors, a transmitted light detector, two non-descanned detectors, and the state-of-the-art META detector with emission finger printing allowing simultaneous detection of up to 8 fluorophores.
- Specimen incubator with temperature, humidity and CO_2 control.
- Computer command center with sophisticated imaging and ratiometric software.

- Zeiss LSM-780 Laser Scanning Confocal Microscope equipped with the following:
  - Zeiss Axioexaminer upright microscope stand with fixed stage
  - 405 nm UV Laser
  - 458/477/488/514 nm multiline Argon Laser.
  - 561 nm HeNe Laser.
  - 633 nm HeNe Laser
  - InTune pulsed white light laser (tunable from 488-640 nm).
  - Fully automated programmable scanning stage.
  - Two conventional fluorescent detectors, a transmitted light detector, and the cutting edge 32-channel GaAsP detector with emission finger printing allowing simultaneous detection of up to 10 fluorophores.
  - Specimen incubator with temperature, humidity and CO_2 control.
  - Computer command center with sophisticated imaging and ratiometric software.
- Zeiss LSM-800 Laser Scanning Confocal/Super Resolution Microscope equipped with the following:
  - Zeiss Axio Observer Z1 microscope stand with fixed stage and Definite Focus™.
  - 405 nm UV Laser.
  - 488 nm solid state laser.
  - 561 nm solid state lase.
  - 640 nm solid state laser.
  - Fully automated programmable scanning stage.
  - Zeiss Airyscan super resolution detector
  - Three GaAsP fluorescent detectors and a transmitted light detector.
  - Specimen incubator with temperature, humidity and CO_2 control.
  - Computer command center with sophisticated imaging and ratiometric software.
- Leica TCS SP5 MP Laser Scanning Confocal Microscope with Multiphoton capability equipped with the following:
  - Leica DM6000 Advanced Inverted Microscope stand.
  - 405 nm UV Laser.
  - 458/476/488/514 nm multiline Argon Laser.
  - 543 nm HeNe Laser.
  - 594 nm HeNe Laser.
  - 633 nm HeNe Laser.
  - Spectra-Physics MaiTai ps TiSa multiphoton near infrared laser (tunable from 700-1020 nm).
  - Fully automated programmable scanning stage.
  - Fully automated motorized lens turret.
  - Four conventional PMT detectors, a transmitted light detector, and the two Non-descanned detectors.
  - Specimen incubator with temperature, humidity and CO_2 control.
  - Computer command center with sophisticated imaging and ratiometric software.
- Leica TCS SP8 Laser Scanning Confocal Microscope equipped with the following:
  - Leica DMi8CEL Advanced Inverted Microscope stand.
  - 405 nm solid-state diode Laser
  - 488 nm solid-state diode Laser.
  - 552 nm solid-state diode Laser.
  - 632 nm solid-state diode Laser
  - Fully automated programmable scanning stage.

    - Fully automated motorized lens turret.
    - Three conventional PMT detectors, a transmitted light detector.
    - Specimen incubator with temperature, humidity and CO_2 control.
    - Computer command center with sophisticated imaging and ratiometric software.
- Zeiss Cell Observer Confocal Microscope based on spinning disk technology equipped with following:
    - Fully automated Zeiss Observer Z1 inverted microscope stand with Definite Focus™.
    - 488/568/633 nm solid state lasers.
    - Yokogawa CSU-X1 microlens-based spinning disk scan-head
    - Dual CCD cameras for simultaneous two-channel detection
    - Fully automated programmable scanning stage
    - Specimen incubator with temperature, humidity and CO_2 control.
    - Computer command center with sophisticated imaging software.
- Zeiss Axiovert-200 inverted fluorescent photomicroscope with color SPOT CCD camera, controlled by an iMac Command Center.
- Leica Mi8 inverted fluorescent microscope with CCD camera controlled by a HP Z-440 Command Center.
- Sartorius Incucyte SX5 live cell analytical imaging system equipped with the following:
    - 4X, 10X, and 20X objectives
    - Triple color filter cube
    - Spheroid imaging module
    - Organoid imaging module
- Sartorius Incucyte SX3 live cell analytical imaging system equipped with the following:
    - 4X, 10X, and 20X objectives
    - Dual color filter cube
- PerkinElmer Vectra Polaris Multiplex Spectral whole slide imager with the following:
    - 10X and 20X objectives
    - 80 slide capacity
    - 6-color plus brightfield imaging.
- PerkinElmer IVIS Spectrum/CT live animal multimodal optical and CT imager.
- Bruker In-Vivo Xtreme live animal multimodal optical, X-ray and Cherenkov radiation imager.
- Siemens Inveon SPECT/CT multimodal small animal imager.
- Bruker Albira MicroPET/CT small animal multimodal imager.
- GE Discovery LS4 clinical/large animal PET/CT imager.
- IThera RSOM Explorer MS-P50 preclinical optoacoustic imaging system
- IThera MSOT Invision whole body preclinical optoacoustic imaging system
- Precision X-ray Irradiator 320
    - Shielded 320 Style X-ray cabinet
    - 320kV Metal ceramic x-ray tube 4500 watts
    - 320kV High stability, high frequency x-ray generator
    - Adjustable multiposition shelf (rotating 52 cm platter)
    - Full screen video monitoring of specimen
    - Environmental controls
    - 2 beam conditioning filters (F1 and F2)
    - Holds up to 11 mice in separate chambers to uniformly radiate during a single exposure
- Cell/tissue culture hood and dual incubators.

- Amnis *ImageStream Mark II* imaging flow cytometer equipped with the following:
    - Six channel detection
    - 405 nm 105mW violet excitation laser
    - 488 nm 200mW blue excitation laser
    - 642 nm 150mW Red excitation laser
    - 785 nm darkfield laser
    - 60X, 40X and 20X MultiMag objective system
- Becton Dickinson Fortessa-1 analyzer equipped with five lasers operating at 355 (UV), 488nm (blue), 405nm (violet), 561 (green) and 633nm (red). The machine has eighteen-color capability,
- Becton Dickinson FACSCanto equipped with three lasers operating at 488nm (blue), 561 (green) and 633nm (red). The FACSCanto has eight-color capability.
- SONY SY-3200 13-color Cell Sorter/Analyzer with the following:
    - 355nm 100mW ultraviolet excitation laser
    - 405 nm 60mW violet excitation laser
    - 488 nm 80mW blue excitation laser
    - 561 nm 75mW blue excitation laser
    - 642 nm 70mW red excitation laser
    - Thirteen-channel detection
    - Computer command center
- Two SONY SH-800 Cell Sorter/Analyzers with four lasers (violet-far red) excitation for six color analysis and computer command center.
- Cytek Northern Lights Spectral Cytometer equipped with 3 lasers and capable of analyzing 24 parameters simultaneously
    - 405 nm violet excitation laser
    - 488 nm blue excitation laser
    - 640 nm red excitation laser
    - high sensitivity Coarse Wavelength Division Multiplexing (CWDM) semiconductor arrays with 38 detectors.
    - 24-channel detection
    - Computer command center
- Leica ARTOS 3D Ultramicrotome equipped with the following:
    - Leica EM Trim-2 Rapid block trimming unit
- Molecular Imaging Portal (MIP), an advanced high-speed central computer system for remote image archiving and analysis:
    - Dell PowerEdge R730 and QNAPQNAP TS-1232PXU-RP-4G controller servers running on Linux platform with 125 tb of storage capacity for image archiving
    - Dell PowerEdge 6800 dual processor application server running Matlab and Definiens Tissue Studio™ and Developer XD™ advanced image analysis software.
    - QNAP Integrated backup system with 220 tb capacity for data backup and archiving.
- Macintosh and PC workstations with advanced image analysis software including Volocity, Huygens, Living Image, PMOD and FlowJo.

Scientific Expertise

Core Director: Kamiar Moin, PhD, Director, has over 30 years of experience in microscopy, imaging and cytometry thus guaranteeing stability of this vital shared resource. He received formal training in all aspects of microscopy and imaging including electron microscopy (both scanning and transmission), fluorescent and confocal microscopy. He is certified in confocal microscopy by George Washington University, Washington, D.C. Having served on several expert panels and

study sections, Dr. Moin is ideally qualified to direct the research capabilities of the MICR Core and recommend scientific methodology to MICR Core users.

Associate Director: Jessica Back, PhD, has extensive experience in flow cytometry and has received cross training on several services in the Core including small animal optical imaging and microscopy. She received formal training in imaging flow cytometry and the operation of the Amnis imaging flow cytometer is one of her primary responsibilities.

Support staff are fully trained and each have in-depth experience in confocal imaging (Linda Mayernik, MS; Acacia Farber-Krug, BS) or flow cytometry (Eric Van Buren, BS) or in vivo imaging (Xin Lu MD; Kirk Douglas, MS). These individuals guide MICR clients in proper use of equipment, recommend techniques and resolve imaging and/or cytometry challenges.

Facility and Administration

Locations: The MICR central imaging site is located on the medical campus and housed in approximately 1000 sq. ft of space on the 6th floor of Scott Hall and a 1000 sq. ft EM lab in 2nd floor of Elliman bldg. The main cytometry location is housed on the 6th floor of the Hudson Webber Cancer Research Center in approximately 1000 square feet of space. The *in vivo* imaging lab for animal imaging is located in the lower level of the Elliman Building, adjacent to a central animal housing location in approximately 1500 square feet of space. Satellite locations have been established at two locations on the university main campus: for confocal imaging, located in the Biological Sciences building, and confocal imaging/cytometry, located in the Integrative Biosciences Center. Total square footage is over 5000.

6339 Scott Hall (Administrative Offices & MICR Microscopy) – 577-2511
2109 Elliman (Electron Microscopy) – 577-2511
615 HW-CRC (MICR Cytometry) – 576-8341
0125 Elliman (MICR In Vivo imaging) – 577-1207; 576-8254
2313 iBio Center (Microscopy satellite location) – 577-2511
0376 Biological Sciences (Microscopy satellite location) -- 577-2511

Access: The MICR core is available to clients from 8:30 am until 5:00 pm. After hours and weekend availability are readily provided but require prior arrangements.

Institutional Support: The MICR Core is supported by the Office of the Vice President for Research and the Karmanos Cancer Institute. In addition to subsidizing usage fees, the OVPR and KCI have and continue to contribute toward the cost of instrumentation and maintenance.

iLab Sollutions: iLab is a virtual software management system that allows easy access to Wayne State University Core Services by investigators throughout the university. Cores using the Infinity scheduling, invoicing and reporting system are able to identify services and associated costs and to make ordering of services available twenty-four hours a day, seven days a week. All communications between the investigator (or his/her designee) within iLab are saved, and status of completion services can be tracked. In most cases, lab results can be provided directly to the investigator online, with exporting into many formats for analysis. iLab software has been integrated with the WSU Banner financial system thus streamlining the reporting process and the expediting reimbursement for services.