The year 2009 was a special year for MCF with a new major equipment acquisition, Zeiss Ultra-55 Field Emission Scanning Electron Microscope with an impressive and state-of-the-art detection and processing capability, and the arrival of Dr. Qi Zhang, a world-renowned expert of Transmission Electron Microscopy. MCF served 135 students and 45 faculty members from 6 different universities as well as 19 scientists/engineers from industry, all gathered to work, think and spearhead cutting-edge research in a variety of fields including materials, optics, biomedical, physics, chemistry and nanotechnology. Our external users included companies located throughout central Florida, from the nearby Research Park to the new medical city located at Lake Nona, as well as education institutions both in and outside of Florida. Our instruments, valued at over $20M and housed at our 10,000 sq. ft. facility, have never been busier. For example our new Zeiss SEM has logged nearly 2,000 hours in 2009 - that is over 8 hours every work day. Our XRD, TEM and FIB have also logged over 1,000 hours each in 2009. Our 20-people classroom, conference room and even the break-room are full of tech talks and face-to-face consultations provided by our staff engineers. In addition to research activities, there is quite an influx of classroom activities (e.g., EMA 3012C, EMA 6518, PHYZ5245C). With this inaugural issue of “STRUCTURE,” we hope to expand our user-base and serve UCF and beyond in search for the next revolution in scientific discovery, techno-economic impact, and education/training for the bright future. We look forward to building “the best characterization facility in the world,” Yongho Sohn, Associate Director for MCF.

UCF MCF is operated by Advanced Materials Processing and Analysis Center (AMPAC). Sudipta Seal, Ph.D. is Director of AMPAC and NSTC.
The Materials Characterization Facility (MCF) of AMPAC welcomes Dr. Qi Zhang, a staff engineer with world-class experience and expertise on transmission electron microscopy (TEM). After being trained on TEM with a Ph.D. in Materials Physics at Tianjin University in China, Dr. Zhang has contributed to various research programs at some of the most prestigious institutes including Tsinghua University in China, National Institute for Materials Science in Japan, Northwestern University (IL), University of North Carolina at Chapel Hill, and Penn State University. With more than 50 journal publications, she has demonstrated her expertise in TEM, scanning electron microscopy (SEM), STEM, and related analytical microscopy techniques including high resolution transmission electron microscopy (HRTEM), diffraction-contrast imaging, convergent beam electron diffraction (CBED), nanobeam electron diffraction (NBD), high angle annular dark field image (HAADF), electron energy-loss spectroscopy (EELS), energy filtered TEM, energy dispersive x-ray spectroscopy (EDS) and in-situ observation at low and high temperature, and specimen preparation. She has experience and expertise in characterization of various classes of materials including metals, semiconductors, intermetallics, insulators, thin metallic films/semiconductor high electron mobility transistors, ferroelectric and piezoelectric thin films, metallic and semiconducting nanowires, nanotubes, semiconductor quantum dots, polymer/nanotubes composites, DNA/nanotube composites, and biological specimens. In addition to experience and expertise in microscopy and the knowledge of related research, she brings ample experience on instrument maintenance, student training and facility development for a multi-user facility like MCF. For those interested in technical consultation and service or training by Dr. Zhang, please contact her at via email qizhang@mail.ucf.edu or by calling 407-882-1511.

UCF is now equipped with an ultra high-resolution field emission scanning electron microscope (FESEM), just installed at the Materials Characterization Facility (MCF). The funds to acquire this latest technology in SEM were contributed by ORC, AMPAC, NSTC, CREOL, COS and FHTCC. MCF, located at the Orlando Tech Center in UCF’s Research Park, is a multi-user facility where students and faculty can be trained and use the latest microscopy and spectroscopy to enhance their research activities. The FESEM acquired is a ZEISS Ultra-55 that offers ultra high resolution for secondary electron image (0.8 nm at 30 KeV and 4.0nm at 0.1 KeV) for surface information from both conducting and non-conducting specimens. It also is equipped with a fully integrated energy and angle selective backscattered electron (EsB) detector for compositional information. Combined with the large multiport analytical chamber, the fully motorized 5-axes stage, and the high current mode, the Ultra-55 also offers superb analytical capabilities. Ultra-55 FESEM at UCF is also equipped with scanning transmission electron microscope (STEM) detection capability for maximum contrast for light element sample such as carbon nanotubes. For chemical analysis, this FESEM is equipped with the latest type of energy dispersive spectroscopy (EDS) detector called a Silicon Drift detector that allows for better detection of light elements and faster data acquisition. UCF’s FESEM does not stop at just “seeing” and “analyzing” small things at nanoscale. Equipped with Nabity electron direct write lithography systems, also known as Nanometer Pattern Generation System (NPGS) and electrostatic beam blanker, this new addition at MCF will push the boundaries of materials processing and analysis at nanoscale. For information on training and usage of this new state-of-the-art instrument, please contact Ms. Karen Glidewell at (407) 882-1500 or kglidewe@mail.ucf.edu or ampacmcf@mail.ucf.edu.
Dr. Ling Lai from Sanford-Burnham Medical Research Institute-Lake Nona

Ling Lai is a staff scientist in the Diabetes and Obesity Research Center at Sanford-Burnham Medical Research Institute-Lake Nona. She received her M.D. from Beijing Medical University in P. R. China in 1992. She was a lecturer in the Department of Cell Biology at Beijing Medical University before moving to the US in 1998. She did her graduate work in Structural and Cellular Biology at Tulane University and received her Ph.D. in 2004. She pursued her postdoctoral training on nuclear receptor signaling and links with transcriptional control of metabolism in the laboratory of Dr. Dan Kelly in the Center of Cardiovascular Disease at Washington University School of Medicine in Saint Louis. In 2008, she relocated to Orlando and joined the Sanford-Burnham Institute for Medical Research in order to continue her work on the transcriptional regulation of metabolism.

Mitochondrial dysfunction in the heart plays an essential role in the impairment of cellular metabolism and progression of heart disease. Dr. Lai’s work focuses on the transcriptional regulatory circuits controlling pathways within the mitochondrion. Using mouse models, she is able to explore the alterations in mitochondrial function and structure relevant to common diseases of the heart including heart failure and diabetes. The transmission electron microscopy studies in the hearts of mice provide a powerful technique to reveal the ultrastructural of the mitochondrion and cardiac muscle. In addition, these studies will address the mechanistic questions regarding the signaling pathways driving cardiac mitochondrial biogenesis and the expression of genes involved in mitochondrial energy metabolism in the diseased heart.

Dr. Jeffrey A. Bean from the College of Optics and Photonics (CREOL)

Jeffrey A. Bean is currently a postdoctoral research associate at the College of Optics and Photonics/CREOL, University of Central Florida. He was born and raised in Casper, Wyoming and attended the University of Wyoming for his undergraduate education, earning his B.S. degree in Electrical Engineering in 2003. Jeff pursued his graduate education at the University of Notre Dame and earned M.S. and Ph.D. degrees in 2005 and 2009, respectively. At CREOL, he is conducting research on antenna-coupled metal-oxide-metal diode (ACMOMD) infrared detectors, studying the effect of device geometry, substrate, and fabrication parameters and their relation to detection characteristics. ACMOMDs are patterned using electron beam lithography and fabricated with shadow evaporation metal deposition.

Jeff utilizes the Zeiss Ultra-55 SEM at MCF to image the electron beam resist after exposure and development to ensure that the lithography has resulted in the proper resist structure. After the shadow evaporation and metal lift-off procedure, he again images the devices to ensure that the proper overlap area of the metal-oxide-metal tunnel diode was achieved, which is approximately 75 nm x 75 nm (see micrograph). The high resolution of the Zeiss Ultra-55 SEM, in addition to its ability to function at low accelerating voltages, allow him to image these nano-scale tunnel diodes and modify device geometries to attain the desired detection characteristics.
The Materials Characterization Facility (MCF) possesses state-of-the-art surface and materials characterization equipment. MCF is dedicated to helping researchers perform cutting edge research and to train and educate students in the successful use of the available instruments. Currently, three full-time engineers (Dr. Qi Zhang, Kirk Scammon and Mikhail Klimov) are available to assist students, faculty and members of the industrial community. Participation from other universities and industries is encouraged. This facility is located in the Central Florida Research Park, adjacent to the UCF campus.

- FEI Tecnai F30 Transmission Electron Microscope
- JEOL 1011 Transmission Electron Microscope
- FEI 200 TEM Focused Ion Beam
- Zeiss Ultra-55 Field Emission Scanning Electron Microscope
- General IONIX 1.7 MV Tandetron Particle Accelerator
- JEOL SuperProbe 733 Electron Probe X-Ray Microanalyser
- Rigaku XRD (X-Ray Diffraction)
- Cameca IMS-3F Secondary Ion Mass Spectrometer (Ion Microscope)
- PHI 560 ESCA (X-Ray Photoelectron Spectrometer/Auger Electron Spectrometer)
- PHI 5400 Electron Spectroscopy for Chemical Analysis (X-Ray Photoelectron Spectrometer)
- PHI 600 Auger Electron Spectrometer/Scanning Auger Microscope
- Hitachi S3500N Variable Pressure Scanning Electron Microscope
- Molecular Imaging PicoSPM (Scanning Tunneling Microscopy, Atomic Force Microscopy)
- Olympus LEXT 2000 Scanning Laser Confocal Microscope
- Renishaw 1000B MicroRaman Spectroscope

Sample Preparation Equipment:

- Critical Point Dryer
- Gatan PECS (Coating System)
- Ion Milling for TEM
- Ultra Microtome (TEM/FTIR Sample Prep)
- Sputter Coater (EMITECH)
- Vacuum Evaporator (JEOL) Carbon Coater
- Diamond Saw (Slow Speed)
- Diamond Band Saw
- Electro Jet Polisher (TEM Prep)
- Dimple Grinder (TEM)
- Allied Polisher (TEM)
- Metallurgical Polisher
- Streuers Polisher
- Plasma Cleaner

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