

UNT's Materials Research Facility (MRF)

University of North Texas

E-178 Discovery Park
3940 North Elm Street
Denton, TX 76207

<https://mrf.research.unt.edu>

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For more information about MRF equipment,
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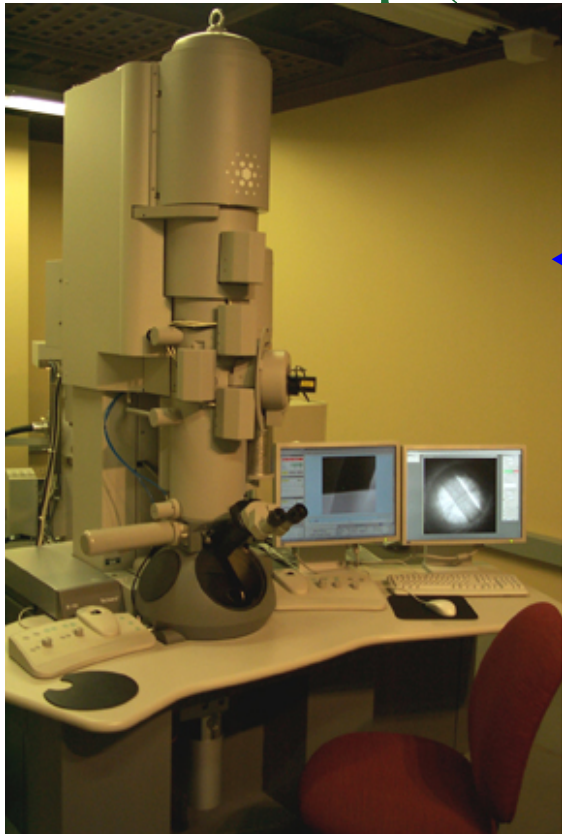
- **The Materials Research Facility (MRF), formerly known as the Center for Advanced Research and Technology (CART) was established at the University of North Texas (UNT) in 2004 through support from the U.S. Army Research Laboratory.**
- **MRF is an umbrella facility that supports a variety of advanced scientific research activities within the university and with external partners. The areas of research encompass many disciplines including, engineering, materials science, physics, chemistry, and biology.**
- **The UNT Discovery Park, a 550,000²ft former Texas Instruments facility, houses the MRF facilities**
- **MRF currently maintains and operates more than 20 instruments for advanced characterization and processing.**

MRF History

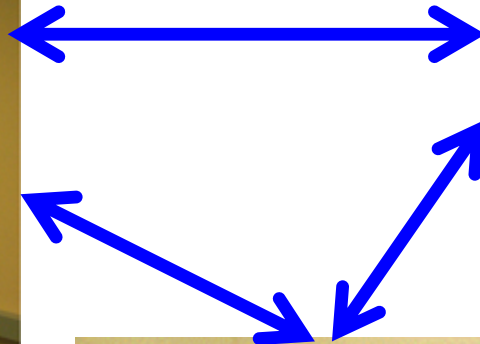
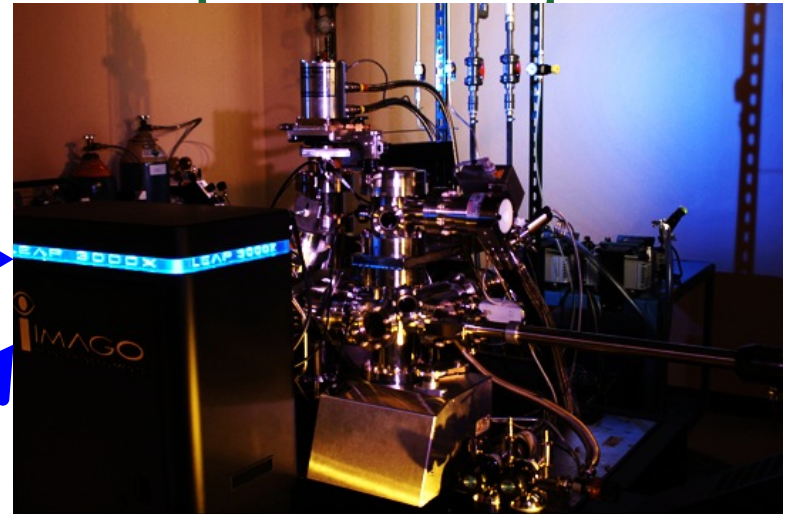
- *2002: UNT establishes College of Engineering in TI building (550k ft² on ~300 acres)*
 - *Materials Science & Engineering Department founded under new College of Engineering*
- *2004: UNT establishes Center for Advanced Research and Technology (CART) under the Office of the Vice-President for Research*
- *2004-2010: CART funded with a Congressional Appropriation of ~\$15M - used primarily for equipment purchases*
- *2012: UNT establishes Nanofabrication Cleanroom (NFCR)*
- *2012-14: UNT is successful in winning an NSF - ARI award - CART instruments centralized into dedicated lab space besides the NFCR lab space*
- *2016: CART & NFCR are merged into the Materials Research Facility (MRF)*
- *2018: UNT's Additive Manufacturing Laboratory (AML) is being established and will become part of the MRF*

Unique Coupling of 3 Instruments

**FEI Tecnai G2 F20 S-Twin 200keV
field emission scanning transmission
electron microscope (S/TEM)**



**CAMECA local electrode atom probe
(LEAP) instrument with added laser-
pulsed evaporation technique**

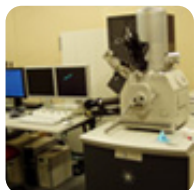


**FEI Nova 200 NanoLab
- a dual column ultra-high resolution field
emission scanning electron microscope
(SEM) and focused ion beam (FIB)**

MRF: Equipment



High Resolution Analytical TEM



Dual Beam FIB/SEM



Local Electrode Atom Probe (LEAP)



High Resolution X-ray Diffraction



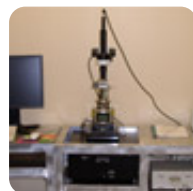
Environmental SEM



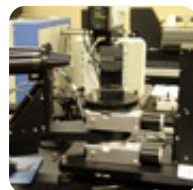
X-ray Photoelectron Spectrometer



Scanning Auger Nanoprobe



Atomic Force Microscopy



Variable Angle Spectroscopic Ellipsometer



Raman Spectrometer

MRF Facilities & Instrumentation

Multidimensional Characterization Lab

- *Cameca LEAP 3000XHR Atom Probe Microscope*
- *FEI Nova 200 NanoLab Dual Beam FIB/SEM*
- *FEI Nova 230 NanoSEM FEG-SEM*
- *FEI Quanta 200 Environmental SEM*
- *FEI Tecnai F20 (200kV) Field Emission TEM*
- *J.A. Woolam Variable Angle Ellipsometer*
- *PHI Versaprobe II XPS/UPS*
- *PHI 670xi Scanning Auger Microscope*
- *Rigaku Ultima III XRD*
- *Skyscan 1172 μ -CT 3D imaging system*
- *Veeco Multimode Nanoscope III SPM*
- *Nicolet Almega XR Raman Spectrometer*
- *Thermo Nicolet 6700 FTIR Spectrometer*

Nanofabration Cleanroom Lab

- *3000 ft² of clean space including Class 100 and Class 10,000 areas*
- *JEOL JSM-7001F SEM EBL pattern writer*
- *Heidelberg DWL 66-fs Maskless Lithography Laser Writer*
- *Oerlikon Leybold Ion Assist E-Beam & Sputtering Thin Film Deposition system*
- *Nanomaster NEE-4000 Dual E-Beam system*
- *Trovato 300C organic deposition system*
- *AGS RIE MPS-150*
- *KLA-Tenco D300 profiler*

Additive Manufacturing Lab (under construction)

- *Optomec LENS 750 Direct Laser Deposition System*
- *Aconity MIDI Powder Bed SLM System*

MRF: External Users

For Profit Institutions

Acorn Technologies	EkoTek Coatings
Alcorn Laboratories	Entergris
Andrew Solutions	Raytheon
ATI Allvac	Shell
Atlas Copco	Halliburton
ConocoPhillips	Johns Manville
Dominion Engineering	Microtech Lab
DRS Tech	Texas Instruments

Non Profit U.S. Institutions

Colorado School of Mines	Del Mar College
Ohio State University	Southern Methodist University
Florida International University	University of Dallas
Canadian National Research Council	University of Texas-Arlington
Texas A&M University	TWU (Westmoreland)
University of Nebraska – Lincoln	
University of Oklahoma (Kane)	
University of Texas – Dallas	

MRF: International Collaborations

Australia: University of New South Wales, Monash University, CSIRO

Brazil: University of Campinas

Canada: Queens University

Germany: University of Mainz

India: Indian Institute of Science, TIFR

Japan: University of Tokyo, Shimane University,
Japan Women's University, Tohoku University

Mexico: Universidad Autónoma del Estado de México

Portugal: University of Aveiro

Singapore: Nanyang Technological University

Slovenia: University of Ljubljana

South Korea: KAIST, KAERI

U. K: Univ. of Strathclyde, University of Birmingham,
Imperial College

MRF organization

- *MRF is a facility under the VPR's office, under the administration of the Assoc. VPR*
- *MRF director in charge of day to day operations, policy development for equipment usage, charging for usage, user training, maintenance, enhancement, and acquisition of MRF equipment etc.*
- *MRF expenses (covered upfront by the VPR's office):*
 - *Service contracts (7 critical characterization equipment out of 15)*
 - *Repairs and upgrades*
 - *Consumables and supplies*
 - *Technical staff support (1 facilities manager + 2 technical staff)*
- *MRF has a faculty advisory committee to advise and aid the MRF Director and the VPR's office*
- *MRF faculty advisory committee also aids in the development of stronger links between MRF and industrial partners interested in using MRF equipment*

MRF Accounting and Billing

- *MRF accounting & billing procedures*
 - Have been well-established and auditable
 - Instrument access and time charges
 - handled by Facility Online Management (FOM) System
 - Various enticements have been engineered to increase research and academic output
- *MRF Small Fee Grant Program*
 - Sponsored research matching grant to leverage current grants
 - Seed/bridging grant to develop new research grants
 - Terminal research grant for completion of a student's degree

MRF integration into Education

- *Training of graduate and undergraduate students in the use of advanced characterization of processing equipment*
- *Impact on undergraduate education*
 - *Senior design projects have a separate budget amount (provided by the department) for the use of MRF equipment*
 - *Juniors and seniors trained on some of the equipment as needed*
 - *Introductory MSE course has a whole lecture period devoted to detailed tour of the facility including specific examples of instrument use*
- *Impact on graduate education*
 - *Course on materials characterization includes substantial use of MRF facilities*
 - *Active use by graduate students in their research projects*
- *Middle and high school students and their science teachers are brought in on a regular basis for tours of the facility*

MRF challenges

- *Recovery from user fees*
 - *User fees kept relatively low*
 - *VPR's office offers effective subsidy to internal UNT faculty users by paying for part of the user fees*
 - *MRF offers small fee grant program to promote usage*
- *Total annual recovery from user fees is only ~15% of total MRF expenses*
- *MRF usage is not sufficient to generate required user fees*
 - *Faculty complain that they do not have enough budgeted in their grants /contracts for using shared facilities*
 - *Faculty try to work with collaborators, in some cases international collaborators, to get their research done, without having to pay user fees*

MRF challenges

- *Training of users*
 - *Less than required MRF-dedicated staff for training on equipment in an expedited manner*
 - *Faculty are not always cooperative in having their trained senior graduate students/post-docs to help out with training*
 - *Requirement of training differs depending on the specific equipment*