

# MECHANICAL CHARACTERIZATION AND ANALYSIS USER CENTER

at the High Temperature Materials Laboratory (HTML)

MCAUC

The Mechanical Characterization and Analysis User Center (MCAUC) specializes in the mechanical characterization of functional and structural materials. MCAUC performs mechanical testing and analysis and develops test methods, design codes, and supplemental analytical techniques. Numerous mechanical test frames with uniaxial and multiaxial capabilities are available to visiting researchers from industry and academia to conduct tests in tension, compression, flexure, torsion, shear, and internal pressurization in controlled environments and at elevated temperatures using standard or customized specimens. Facilities also include equipment for micromechanical testing and instrumented indentation. Staff has expertise with a wide range of materials, testing configurations, failure analysis, finite-element stress analysis, analytical modeling, and life-prediction analysis of materials and structures.

## Tensile Test Facility

- ❑ Several electromechanical and servohydraulic testing machines with load capabilities of up to 500 kN and testing frequencies of 3000 Hz
- ❑ Monotonic or cyclic testing
- ❑ Load train configurations with fixed alignment or self alignment
- ❑ Active and passive grips for a wide array of specimen geometries
- ❑ Digital controllers for load, displacement, or transducer-driven control, and computerized data acquisition

## Creep, Stress Rupture, and Stress Relaxation Test Facility



- ❑ Several electromechanical, dead weight, and lever arm testing machines with load capabilities of up to 500 kN for tests in tension or compression
- ❑ Digital controllers for load, displacement, or extensometer-driven control, and computerized data acquisition

## Flexure Test Facility

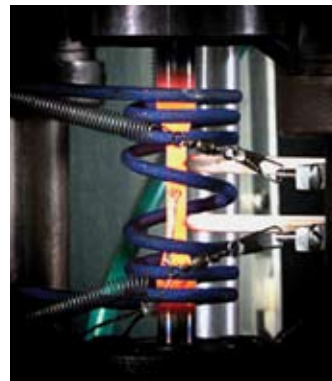
- ❑ Four test frames with pneumatic actuators, each with loading capacity of 22 kN and capability for testing three samples simultaneously up to 1600°C in air
- ❑ Several electromechanical and servohydraulic testing machines with load capabilities of up to 500 kN
- ❑ Static, dynamic, and low-cycle fatigue
- ❑ SiC and Al<sub>2</sub>O<sub>3</sub> fixtures for uniaxial and biaxial bending of standard and nonstandard specimens of various sizes

## Stress and Life-Prediction Analysis

- ❑ FEA
- ❑ CARES

## Thermomechanical Fatigue

- ❑ Several servohydraulic testing machines with load capabilities of up to 500 kN for tests in tension, compression, and torsion
- ❑ Digital controllers for load, displacement or strain control, and computerized data acquisition
- ❑ Bottom-drop furnace for rapid heating/cooling
- ❑ Thermal shock testing
- ❑ Rotary bend fatigue machine equipped with furnace for testing small cylindrical specimens in fully reversed cyclic loading



## Resonant Ultrasound Spectroscopy (RUS) Facility

- ❑ Characterization and inspection of mechanical integrity of test specimens and components
- ❑ Determination with high accuracy of the elastic constants of isotropic and anisotropic materials at ambient and elevated temperatures

## Fixtures, Accessories, and Special Configurations

- ❑ Fixtures for uniaxial and biaxial bending, Iosipescu shear testing, antibuckling compression, and interlaminar shear by compression of double-notched specimens

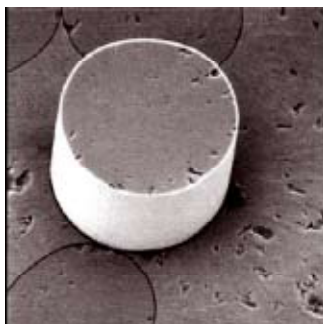
## Mechanical Properties Microprobes

- ❑ Special microhardness tester capable of operating at four load ranges (0–4, 0–20, 0–100, and 0–650 mN) with constant monitoring of load and position of indenter relative to surface of specimen
- ❑ Plastic and elastic components of displacement are separated either by continuous sensing of sample stiffness while force is being applied or by calculating the hardness based on the recorded measurements of load vs displacement
- ❑ Spherical, flat, and sharp diamond indenter tips

## Environmental Testing

- ❑ Environmental chambers for testing in inert environments or vacuum levels of  $1 \times 10^{-9}$  torr
- ❑ Environmental chambers for testing in pressurized simulated industrial environments (e.g., steam) up to 1200°C
- ❑ Microturbine test facility for screening and evaluating candidate materials for microturbine recuperators

## Raman Spectroscopy



- ❑ Measurements of stress, phase content, and structure in nonmetallic materials with a spatial resolution of  $\sim 2 \mu\text{m}$
- ❑ Laser and optics optimized for operation in the UV, which allows for Raman spectral measurements up to  $1500^\circ\text{C}$
- ❑ Low-dispersion spectrograph for one-shot photoluminescence and full-range Raman measurements
- ❑ Loading fixture for in situ measurements and fiber optics for remote sampling

## FTIR

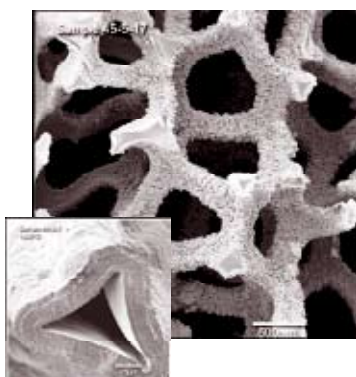
- ❑ Optical spectrometer for FTIR with a range of  $7,400\text{--}350 \text{ cm}^{-1}$  and spectral resolution of  $0.125 \text{ cm}^{-1}$
- ❑ System attached to an IR microscope with spatial resolution of  $\sim 10 \mu\text{m}$

## Additional MCAUC Capabilities

- ❑ Infrared imaging
- ❑ Detection of acoustic emissions
- ❑ Strain-gaging facilities
- ❑ Internal pressurization of tubular components

## Materials

- ❑ biomaterials
- ❑ ceramic fibers
- ❑ concrete
- ❑ electronic materials
- ❑ fiber- and particulate-reinforced polymer, metal and ceramic matrix composites
- ❑ foams and porous media
- ❑ ceramic and metallic filters
- ❑ glasses
- ❑ magnetic materials
- ❑ refractories
- ❑ monolithic ceramics
- ❑ thermal and environmental barrier coatings
- ❑ functional coatings and thin films



- ❑ conventional alloys, superalloys, intermetallics, and lightweight materials
- ❑ metallic foils

## MCAUC Staff

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