

# **EQUIPMENT AND LABORATORY FACILITIES AT CSM**

## **1. Electron Microscopy**

Electron Philips CM200 Scanning - Transmission Microscope with Energy-Dispersive Spectroscopy  
Philips EM 400 Transmission Electron Microscope  
JOEL JXA - 840 Scanning Electron Microscope with Energy-Dispersive Spectroscopy  
Digital Instrument Atomic Force Microscope

## **2. Nuclear Magnetic Resonance**

NMR - 400 Mhz Liquid - Solids NMR Spectrometer

## **3. Chemical and Structural Analytical Facilities**

Optima 3000 ICP Spectrometer  
Cray 5 U.C. Spectrophotometer  
Leco Interstitial Analyzers  
Complete Hydrogen (diffusible and total) Analyzer  
Mossbauer Spectrometers  
UV Spectrometers  
Chromatographs  
X-ray Diffraction Systems

## **4. Electronic Materials Characterization**

JA Woolham Spectroscopic Ellipsometer  
Three Wavelength Gaertner Ellipsometer  
Tencor Temperature Dependent Hall Effect Analyzer  
Low Temperature Photoluminescence Spectrometer  
C-V, I-V, PV Efficiency Instruments  
Near Field Scanning Optical Microscope  
Varian Ion Implanter

## **5. Electronic Materials Processing Facility**

1000 sq. ft. Class 1000 Clean Room  
3000 sq. ft. Thin Film Deposition Facility

## **6. Physical Characterization**

Netzsch Simultaneous Thermal Analyzer  
Netzsch High Temperature Dilatometer  
Netzsch Differential Scanning Calorimeter  
Netzsch Thermal conductivity tester  
Seiko TG/D and Cahn TGA Both Interfaced to a Fisons Mass Spectrometer  
Bio-Rad Fourier Transform Infrared Spectrometer  
Thermal Conductivity

## **7. Polymer Characterization**

Perkin-Elmer Differential Scanning Calorimeter  
Kayeness Capillary Rheometer  
Wyatt Technologies Laser Photometer  
Light Scattering Apparatus  
Rheometrics Dynamic Rheometer

## **8. Computational Resources**

IBM SP-Z 8-Node Parallel Supercomputer  
SGI Indiago 2 Workstation Clusters  
IBM RS-6000 Workstation Clusters  
Large Format Dye Sublimation Color Printer  
2 Color Laser Printers  
SGI 6 Processor Power Challenge  
1 Color Scanner

## **9. Commercial Codes**

Process Simulation Software - Aspen  
Finite Element Software - Abacus  
Quantum Mechanical Software  
- Gaussian 94 Spartan  
Materials and Molecular Modeling Packages - Cerius 2

## **10. Mechanical Testing and Forming**

4 MTS Computer-Controlled, Servo-Hydraulic Uniaxial Testing Units  
2 Instron Screwdriver Uniaxial Testing Units (one with high temp-control arm capability)  
4- and 3- Point Bend Fixture (ambient and high temp)  
MTS Nano Indenter XP  
Sheet Metal Testing Fixtures  
Fracture Toughness Fixtures  
Instrumented Impact Tester and Numerous Other Impact Testers  
Fatigue Testing: Revised Bending and Torsional Fatigue Testing Machines  
A Wiredrawing Bench  
Hot and Cold Rolling Mills  
Numerous Hardness Testers  
Thermal Technologies Hot Press System (ZST Capacity, Vacuum, 3300fC)

## **11. Coating/Thin Film Testing and Deposition System**

Scratch/adhesion Tester  
Wear Tester  
Profilometers  
8,000 Square Feet Thin Film Labs (2 clean rooms)

VAC TEC, VCC 7740 Vertical Cathode PVD Unit  
VAC TEC, MLIV Horizontal Cathode PVD Unit  
Varian Ion Implantation  
Hyper Ion PVD Unit  
Electron Beam & Thermal Evaporation Units  
Perkin Elmer RF Sputtering System 2400-8SA  
Closed Field Unbalanced Magnetron System  
Watkins Johnson Atmospheric Pressure CVD Unit  
Plasma Enhanced CVD Unit  
Laser Surface Modification Facilities

## **12. Joining and Welding Laboratory**

Complete Arc Welding Capability  
Laser Welding System  
Solid State Bonding  
Soldering and Brazing Capability  
Fixtures for Hot Cracking Susceptibility Testing  
Gleeble Thermomechanical Simulator  
Experimental Welding Consumable Production Capability  
Underwater Welding

## **13. Mass Spectrometer**

Extrel ELQ - 400 Triple Quadrupole Mass Spectrometer  
Extrel ELQ - 400 LC/MS Triple Quadrupole Mass Spectrometer  
Perkin Elmer Q-Mass 910 GC/MS Systems  
JOEL M Station High Resolution Mass Spectrometer

## **14. Metallography and Optical Microscopy**

Specimen Preparation Capability  
Numerous Metallographic Systems and Microscopes  
Image Analysis  
Hardness testers  
Numerous Heat Treatment (vacuum and air) Systems  
Photographic Equipment

## **15. Corrosion and Surface Analysis**

EG&G PARC 273 Potentiodynamic Analytical System  
Salt Spray Corrosion Testing  
High Temperature Corrosion Testing  
PH and Selective Electrode Sensors  
XPS  
Auger Electron Analysis  
SIMS  
Schlumberger 1255 High Frequency Response Analyzer

3852 HP Data Acquisition System  
Cyclic Voltammetry Measurement  
Electrochemical Impedance Analyzer  
Ellipsometer  
Surface Area Analyzer

**16. Pyrochemical Capabilities**

Molten Salt Electrorefining  
Molten Salt Electrowinning  
Molten Salt Heat Treatment Baths  
Smelting Capabilities  
High Temperature Melting Furnace  
Vacuum Industries Inductotherm Vacuum Furnace (2200fC)  
Seven Protective Atmosphere Boxes with nitrogen and moisture control

**17. Hydrometallurgical Capabilities**

Leaching Systems  
Precipitation Systems  
Analytical Support  
Sol Gel Processing

**18. Particulate Processing and Analysis**

Powder Metallurgy Processing  
Mineral Processing  
Ceramic Particulate Processing  
Particle Size Analyzer

**19. Nuclear Radiation Analysis**

High Gamma Ray Detection with Simulation Detectors  
Resolution Gamma Ray Detection with Semiconductor Detector  
Charge Particle Detection with Semiconductor Defectors  
Neutron Activation