Combined Nanoindentation-Raman Spectroscopy

Description
Combined nanoindentation-Raman spectroscopy systems can be operated independently or together. The combined system has the unique ability to evaluate nano- to micro-mechanical properties and to correlate these properties with measures of chemistry and material structure (e.g., crystallinity, alignment, etc.) at the exact same site evaluated for properties. Basic capabilities lie in the opportunity to evaluate properties at nano- to micrometer length scales (evaluation of properties in very small samples of materials) as well as the ability to evaluate properties in heterogeneous or functionally graded material systems, assessing material aging or degradation with environmental or other exposure, and evaluating properties of hydrated and/or highly compliant materials (e.g., hydrogels, very soft polymers, tissues). Expertise in using these techniques to study biomedical materials for tissue engineering, tissue repair, and for use in biomedical devices, among other areas. Techniques used to study material developed for use in novel MEMS devices, solar panels, and lithium batteries. The applications are almost endless. Customized and Consulting Services are available.

Technical Equipment and Services
- Atomic Force Scanning Probe Microscopy & Nanomechanical Property Measurements

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>KEY/TECHNICAL SPECIFICATIONS</th>
<th>TEST/ANALYSIS</th>
</tr>
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<tbody>
<tr>
<td>Hysitron TI-950</td>
<td>Hysitron’s performech™ advanced control module with force and displacement feedback control loop rate and user definable data acquisition rates up to 30 kHz for superior control over all nanomechanical testing techniques</td>
<td>Quasistatic testing for modulus, hardness &amp; nanoscratch testing using 2D testing head (12 mN max load)</td>
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<tr>
<td>Triboindenter</td>
<td>Dual head testing capability providing an available force range from ≤30 nN to 10 N for true nano-micro scale connectivity</td>
<td>Dynamic testing and frequency sweeps (18 mN max load)</td>
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<td>Automated testing for high throughput and statistical sampling of materials</td>
<td>Scanning Probe Microscopy (SPM) and modulus mapping</td>
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<td>In-situ imaging provides nanometer precision test positioning and the convenience of SPM topography</td>
<td>High load head (500N max load)</td>
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<td>Engineered acoustic and thermal enclosure, along with a stable transducer design and active vibration dampening, minimizes test setup and stabilization time</td>
<td>Extended displacement stage for testing highly deformable materials (e.g., soft polymers)</td>
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<td>Top-down, high resolution color optics for viewing and selection of testing sites</td>
<td>Fluid probes for testing hydrated or submerged materials</td>
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<tr>
<td></td>
<td>500 nm resolution staging for precise sample positioning</td>
<td>Thermal stage (up to 200°C) to enable testing from -4°C to 200°C</td>
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<td>Numerous add-ons that provide the widest array of testing capabilities on the market</td>
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Research Services

Ferguson Laboratory
Mechanical Engineering
College of Engineering & Applied Science
University of Colorado Boulder

Availability: Case-by-Case
- Campus-All
- Government/Academic
- Industry

Equipment Operation:
- Technician
- Customer or Technician (*)

How to Proceed
- Contact Lab (See Below)
- Determine Service Needs & Expectations
- Service Quote Provided
- Customer Provides Necessary Materials/ Data for Processing, If Applicable
- Complete Training for Outside Users, If Required
- Test/Service Performed

Access Details
Regular Business Hours
Monday – Friday 9am-5pm

Request for Lab Services
Virginia (Ginger) Ferguson
virginia.ferguson@colorado.edu
303-887-5693

Lab Website
Combined Nanoindentation-Raman Spectroscopy

Potential Areas of Use

- Metrology
- Polymer & Other Soft Material Synthesis
- Additive Manufacturing (3D Printing) to Assess Printed Material Properties
- Dental Materials Manufacturing (e.g. dental adhesives)
- Electronic Component Manufacturing
- MEMS & Other Small Scale System Manufacturing
- Energy Materials (photovoltaics, battery materials, etc.)
- Biomedical Devices & Biomaterials
- Membranes for Filtration Assessment
- Thin Films Assessment
- Small Volume of Materials Property & Chemistry Assessment

Benefits

- Only three nanoindenter systems exist in Colorado.
- CU-Boulder’s nanoindenter systems is unique from other Colorado systems. For example, it is able to optimize for testing hydrated and/or highly compliant materials with expert researchers in testing metals and glass.
- CU-Boulder’s system is the only system in the world connected to a Raman spectrometer to enable one-to-one correlation of nano/micromechanical properties with chemistry and structure assessment.
- The nanoindenter and Raman spectrometer are frequently operated separately but can also be operated to perform combined property-chemistry assessments.

Rates

Contact the facility for current rates/fees.

Research Services

Lab Research Areas

- Primary Research Area: Biological Tissues
- Specialization: studying how the quality or the underlying microstructure, composition, and material properties of tissues influence the resulting mechanical behavior and, especially, how these behaviors are altered by disruptive mechanical loading, aging, or disease

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<td>Reinshaw In Via Raman Spectrometer *</td>
<td>514 nm (green) and 785 nm (red) laser with Renishaw Wire data collection and analysis software</td>
<td>Collection of Raman spectra</td>
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<tr>
<td>Combined Nanoindentation &amp; Raman Spectroscopy</td>
<td>Fiber optic probes couple the Raman with the optical setup on the nanoindenter to evaluate nano- to micro-mechanical properties and to correlate these properties with measures of chemistry and material structure (e.g., crystallinity, alignment, etc.) at the exact same site</td>
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The provision of the described goods, service, or facility is substantially and directly related to the instructional, research, or public service mission of the University of Colorado Boulder.