UPGRADE OPTIONS

HYSITRON™

Electrochemical Nanoindentation Cell

The **Electrochemical Nanoindentation Cell** (ECNI Cell) is designed to expand the range of environmental conditions that can be controlled during nanoindentation and tribology experiments. The sample surface potential can be controlled through a bias voltage applied to the sample. The material behavior can thus be studied under oxidizing and reducing conditions. Corrosion effects and the formation of oxide under different surface potentials can be studied, as well as the effect of the monolayers of material that form. The ECNI Cell allows all standard testing techniques, such as – indentation, scratch, wear, and *in-situ* SPM imaging experiments.

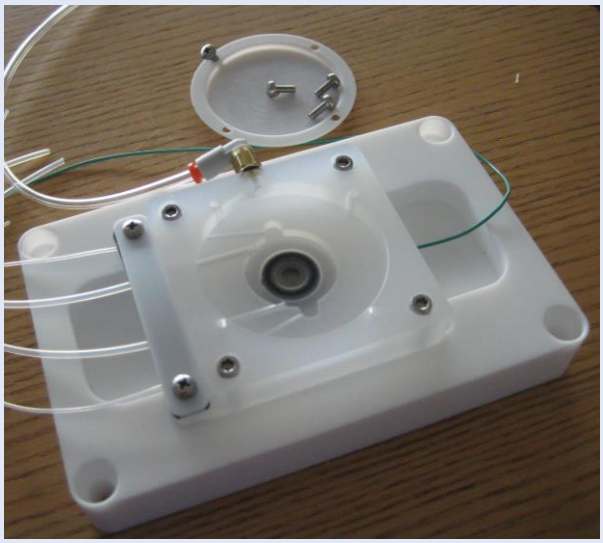

Figure 2. Photograph of the EC-Cell – the top cover to allow a controlled atmosphere has been removed.

Unique Capabilities

The ECNI Cell is designed with a bottom electrode that is used to support the sample mechanically during testing and is also able to apply a bias voltage to the sample surface. The sample is sandwiched between the top cover with a sealing ring and the bottom electrode, forming a small chamber that can be filled with a fluid for the electrochemical experiments. Two ports are designed to constantly exchange the fluid thru an inlet and outlet tube. The reference and the counter electrode can be interfaced through two additional ports in proximity to the sample. A thin cover is placed over the cell to minimize exposure to ambient atmosphere. The gas above the fluid can be controlled through an additional gas port which may be used to purge ambient atmosphere from the cell.

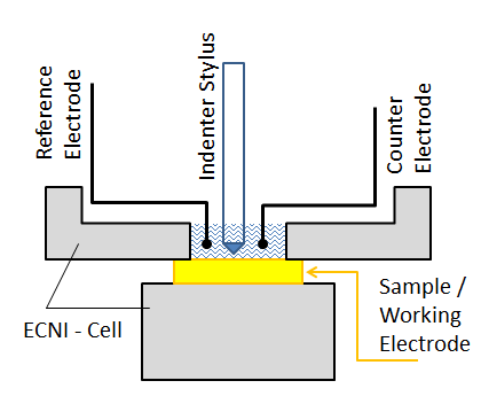

Figure 1. EC-Cell Schematic when used with a Bi-Potentiostat.

The sample is mounted above a recessed volume that is used to contain any excessive liquids which spill from the cell. This volume is large enough to also allow mounting standard microscopy glass slides in the ECNI Cell – thereby expanding the testing capabilities towards standard templates used in the biological field.

The unique stage concept of the **TI 750 Ubi**™ and **TI 950 TriboIndenter**® compliment the ECNI Cell design by allowing the tip to travel 50 mm in the indentation direction. The indenter can then be used to measure very small recessed volumes in the ECNI Cell, where the sample surface is approximately 10 mm lower than the upper extremes of the ECNI Cell.

The ECNI Cell is manufactured out of chemically inert materials, thereby allowing the widest range of environmental conditions within fluids.

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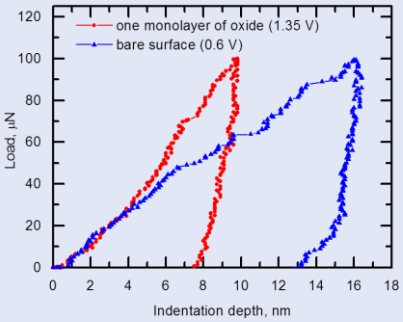
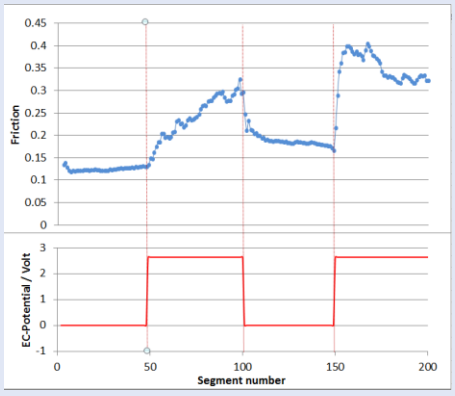
Simplified Testing in Fluids and Corrosive Environments

The ECNI cell is appropriate for any application where nanoindentation testing, scratch testing, or SPM imaging must be performed on a sample in a hydrated condition. It simplifies the test setup for experiments ranging from simple testing of samples in water to studying the mechanical effects of complex electrochemical interactions. Since chemical reactions between the sample and the solution occur at the surface, nanomechanical techniques are particularly well-suited to studying these phenomena. The ECNI cell expands the range of possible experiments in the TI 950 and TI 750 nanomechanical test instruments and greatly simplifies testing in hydrated conditions.

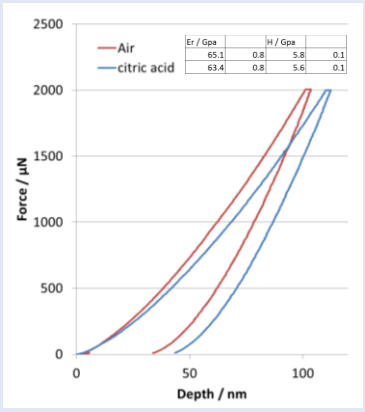
Application Examples



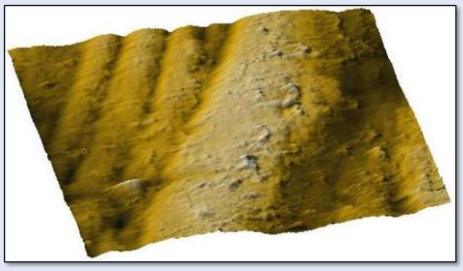
Surface Science: Effect of a monolayer of oxide growing under 1.35V potential on the Au <100> surface



Tribology: Cyclic scratch experiment with 100µN normal load on a gold surface. The friction between indenter and surface changes with the potential applied to the surface. Scratch length 2µm



Corrosion: Soda lime glass is changing its surface properties under the influence of a 1-mole-solution of citric



Testing of samples under fluid: Cortical Bone study; 50µm in-situ SPM image of cortical bone: Collaborator: University of Illinois at Urbana-Champaign.

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HIGHLIGHTS

- Integrated fluid inlet and outlet to maintain constant solution concentrations
- Integrated sample electrode and passages for counter and reference electrodes – ready to be used for state of the art experiments controlled by a Bi-Potentiostat.
- Investigations of reaction mechanisms related to redox chemistry and other chemical phenomena with this setup.
- Small solution volume required.
- Optional atmosphere control
- Constructed from chemically inert fluoropolymer materials
- Flexibility in the sample height.
- Allows holding standard microscopy glass slides.
- Integrates with most Hysitron modes found on the TI-series.

APPLICATIONS

- Battery and energy storage technologies
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- Hydrogen embrittlement studies
- Accelerated corrosion experiments
- Hydrated material testing
- Tribology
- Biological tissues
- *In-situ* testing of mechanical effects of surface chemistry in an aqueous environment

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