Electrochemistry Cell for the MFP-3D™ AFM

Asylum Research

Introduction

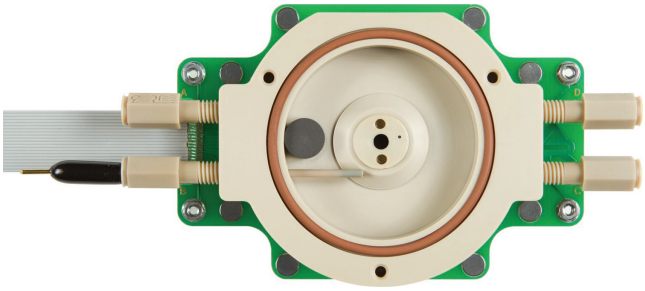
The **Electrochemistry Cell** (**EC Cell**) for Asylum Research **MFP-3D** Atomic Force Microscopes enables studies of deposition, oxidation, corrosion, and mass transfer of metals and other materials. Nanoscale topographical changes can be precisely monitored *in situ* as induced by electrochemical reactions. The cell provides for heating from ambient to 60°C (optional) and can be operated in a fully sealed configuration.

The EC Cell is a versatile platform for electrochemical experiments combined with AFM imaging. At the core of the device is a PEEK container with ports for fluid exchange and electrical feedthroughs. A variety of electrodes is supplied with the EC cell, yet the design is extremely adaptable to accept customized sample mounts or electrodes.

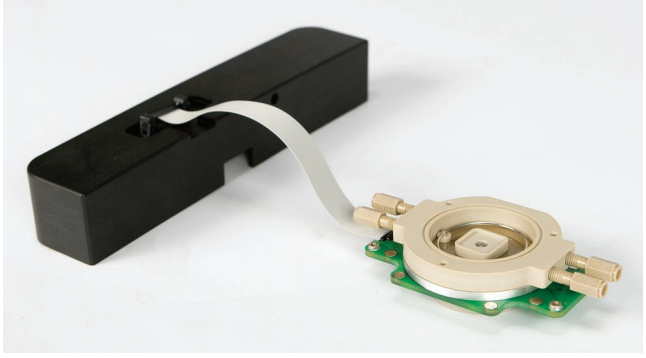
All parts of the EC Cell that come into contact with the electrolyte are made of PEEK polymer. Supplied O-rings are made of FKM (Viton® equivalent) in industry-standard sizes; additional O-rings made of Kalrez® or Teflon® may be purchased separately. The specialized cantilever holder included in the kit is designed such that only the PEEK body and a small quartz window make contact with the electrolyte, avoiding contamination of the cell's contents.

The EC Cell is supplied with a variety of sample mounts which enable press fitting or epoxy potting of various electrode materials. Asylum Research can assist with any specialized sample mounting needs. The EC Cell is easily disassembled for cleaning and samples can be readily removed for cleaning or polishing. The cell's fluid ports enable straightforward exchange of electrolyte.

The kit includes a graphite counter electrode as standard. A platinum counter electrode is available (optional). Metal wires of up to 1/16" diameter can be fed into the cell through two side access ports. Teflon tubing with a variety of inner diameters is supplied to seal around smaller diameter wires. The wires are easily connected at any of four places on the outside of the EC Cell body.



The EC Cell



The EC Cell with heater plate, provides heating from ambient to 60°C. The heater allows, for example, studies of electrolytes which are not liquids at room temperature.

All electrodes are connected to a built-in circuit board which routes signals to a junction box. The junction box attaches securely to the AFM base and offers connection to third-party potentiostats via standard banana plug or 2mm connectors. This arrangement keeps cables and clips/connectors away from the sample, making for a tidy experiment with minimal chance of short circuits, and avoiding disturbance of the sample by eliminating cable movement. The junction box can also be connected to the MFP-3D Environmental Controller to drive the electrolyte heater. An optional heating element enables the investigation of thermodynamics and kinetics of electrochemical reactions, such as the temperature dependence of:

- Electrochemical parameters such as pK_a
- Acceleration of corrosion
- Protein/enzyme turnover rates

OXFORD INSTRUMENTS

The Business of Science®

Specifications

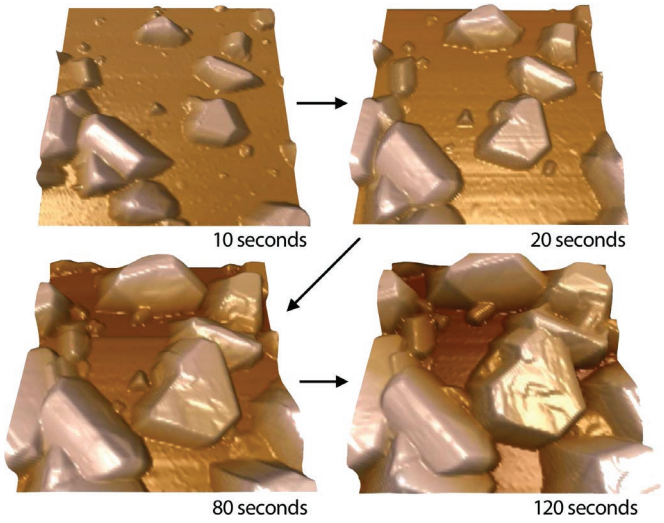
The Electrochemistry kit includes the EC cell, sample mounts, a chemical resistant PEEK cantilever holder, and an accessory kit containing an initial supply of consumable items required for operation. The EC Cell also requires the Environmental Controller if it is configured for heating, which must be purchased separately and can be shared with other MFP-3D environmental control accessories.

Electrochemistry cell

- Chemical resistant cell with volume-reducing insert sample mount
- Fully-sealed, liquid-filled Ag-AgCl reference electrode
- Graphite counter electrode (optional platinum counter electrode)
- Two fluid ports
- Two ports for fluid or wire feedthroughs
- FM membrane for sealing (FFKM optional)
- Optional electrolyte heater heats up to 60°C
- Inquire about specific chemical compatibility

Acknowledgement

The EC Cell was developed in collaboration with the research group of Prof. Richard Compton of the Chemistry Department at the University of Oxford, UK (see references below).



In-situ AFM images of bismuth electrochemical deposition on a boron doped diamond electrode performed using the MFP-3D AFM and Electrochemical Cell (10s, 20s, 80s and 120s reaction times). 1.5 µm scans. Note the same position is scanned each time showing the bismuth crystals growing in size. Sample courtesy of Professor R. Compton, Oxford University.

References

1. K.E. Toghill, L. Xiao, M.A. Phillips, R.G. Compton, The non-enzymatic determination of glucose using an electrolytically fabricated nickel microparticle modified boron-doped diamond electrode or nickel foil electrode, *Sensors and Actuators B* **147**, 64 (2010).
2. N.R. Stradiotto, K.E. Toghill, L. Xiao, A. Moshar, R.G. Compton, The Fabrication and Characterization of a Nickel Nanoparticle Modified Boron Doped Diamond Electrode for Electrocatalysis of Primary Alcohol Oxidation, *Electroanalysis* **21**, 2627 (2009).
3. K.E. Toghill, G.G. Wildgoose, A. Moshar, C. Mulcahy, R.G. Compton, The fabrication and characterization of a bismuth nanoparticle modified boron doped diamond electrode and its application to the simultaneous determination of cadmium(II) and lead(II), *Electroanalysis* **20**, 1731 (2008).

6310 Hollister Avenue
Santa Barbara, CA 93117
Voice +1 (805) 696-6466
Toll free +1 (888) 472-2795
Fax +1 (805) 696-6444
www.AsylumResearch.com
info@AsylumResearch.com
sales@AsylumResearch.com