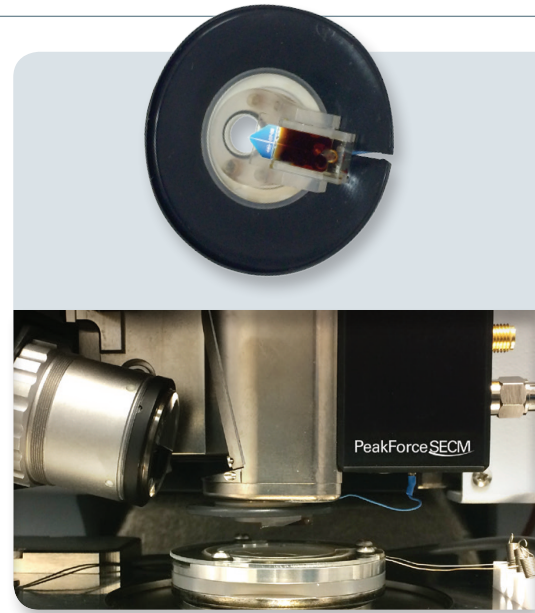


PeakForce SECM

- AFM-Based Scanning Electrochemical Microscopy and In Situ Electrical Mapping in Liquid

High-Quality, High-Consistency Nanoelectrode

Bruker's exclusive PeakForce SECM™ mode is the world's first complete commercial solution for AFM-based scanning electrochemical microscopy (SECM) with a spatial resolution less than 100 nanometers. Utilizing an innovative probe design, AFM-based SECM with nanoscale resolution is now widely available for emerging research on chemistry kinetics, biochemical signaling and environmental chemistry. In addition, PeakForce SECM uniquely provides simultaneous capture of topographic, electrochemical, electrical, and mechanical maps with nanometer-scale lateral resolution. PeakForce SECM takes advantage of this technology to radically redefine what is possible in the nanoscale visualization of electrical and chemical processes in liquid.

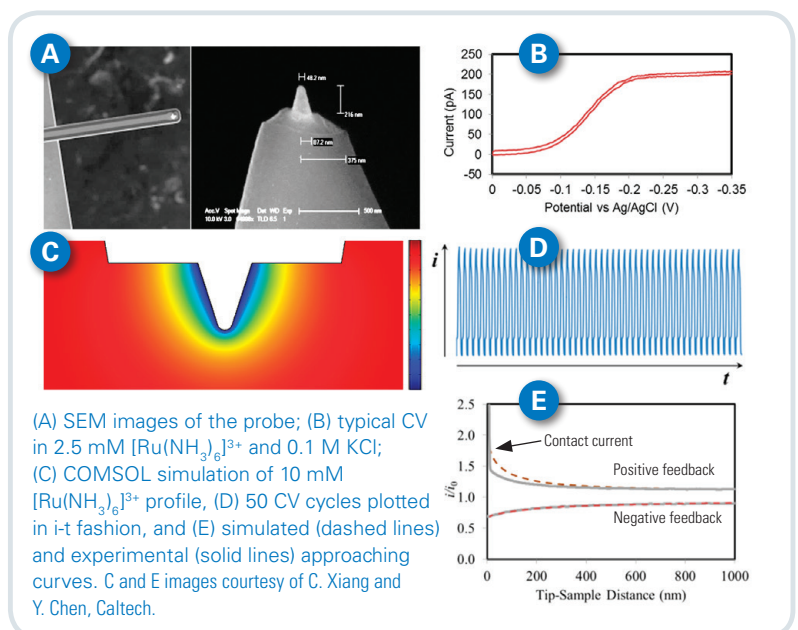


PeakForce SECM delivers, for the first time:

- Previously unobtainable electrochemical information with <100 nm spatial resolution
- Simultaneous electrochemical, electrical, and mechanical mapping in liquid
- Reliable, easy-to-use commercially available probes specifically designed for SECM
- Highest resolution SECM and atomic force microscopy performance with a Dimension Icon® AFM

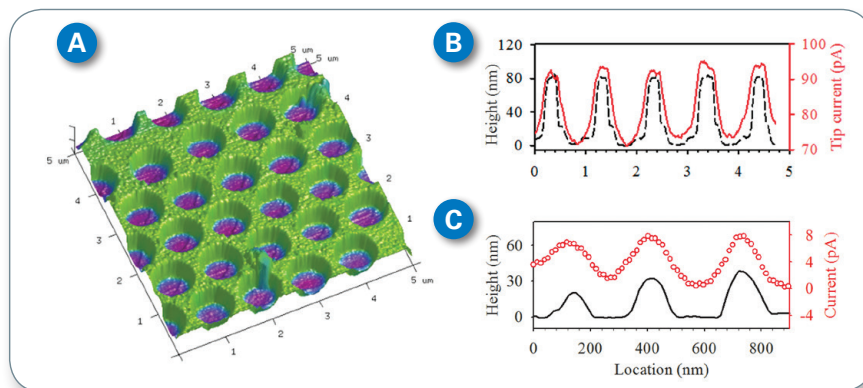
High-Quality Nanoelectrodes

Bruker's PeakForce SECM probes are batch-fabricated using proprietary methods that consistently assure a high-quality nanoelectrode. The optimized conductive path and special coating techniques eliminate pinholes, resulting in negligible leakage and capacitive currents. The highly localized (~100 nanometer) diffusion layer makes high-resolution imaging possible. Premounted probes, designed specifically for easy and safe handling, and an optimized holder produce an electrically stable architecture for sensitive signal processing. As a result, approach curves show high-spatial sensitivity, with electroactive species signals in the 100 nanometers range from the surface. Extremely stable probe performance has been demonstrated for more than 10 hours EC testing and multiple reuse cleaning cycles.



• Highest Resolution Scanning Electrochemical Imaging

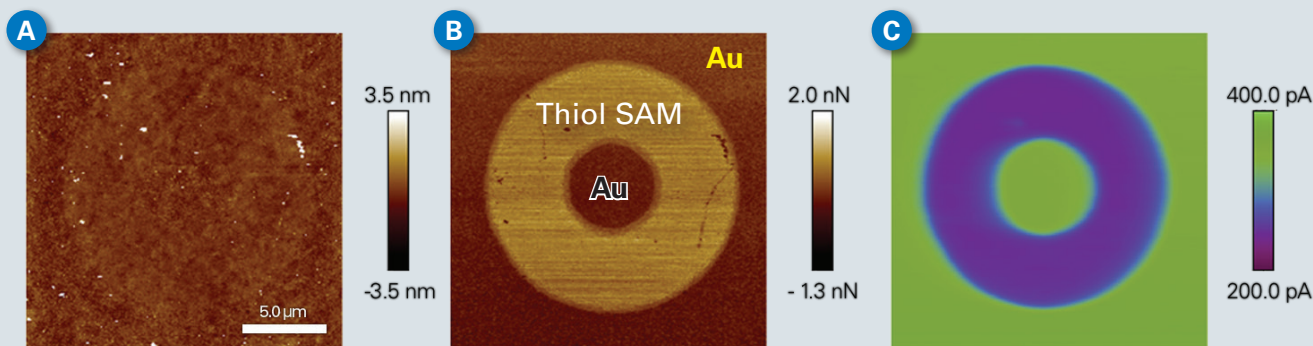
The combination of Bruker's high-performance Dimension Icon AFM, proprietary precise probe positioning, and the unique SECM nanoelectrode makes EC mapping with less than 100-nanometer spatial resolution a reality. This is the highest resolution routinely achieved by a commercial solution. PeakForce SECM dramatically improves, by orders of magnitude, the resolving power over traditional approaches, and opens the door to novel measurements on individual nanoparticles, nanophases, and nanopores.



(A) 3D topography of a nanomesh electrode (Au-SiO₂) covered by EC current skin; (B) line profiles of the topographic and EC variations on the Au-SiO₂ surface in (A); and (C) line profiles of the topographic and EC variations from a nanoelectrode array sample. Nanomesh electrode sample courtesy of C. Stelling and M. Retsch, University of Bayreuth. Image courtesy of A. Mark and S. Gödrich, University of Bayreuth. Nanoelectrode array sample courtesy of M. Nellist and Prof. S. Boettcher, University of Oregon.

Powered by Exclusive PeakForce Tapping Technology

Bruker's exclusive PeakForce Tapping technology applies a precisely controlled force curve at every pixel. This enables the use of drastically reduced imaging forces, which protect the sample and probe while providing the highest resolution for both topography and nanoscale property mapping. PeakForce SECM takes full advantage of PeakForce Tapping to deliver a new approach to SECM that extends its capability to nanoscale electrochemistry, electrical and mechanical mapping of a wide variety of samples, such as soft and fragile biological systems and polymers.

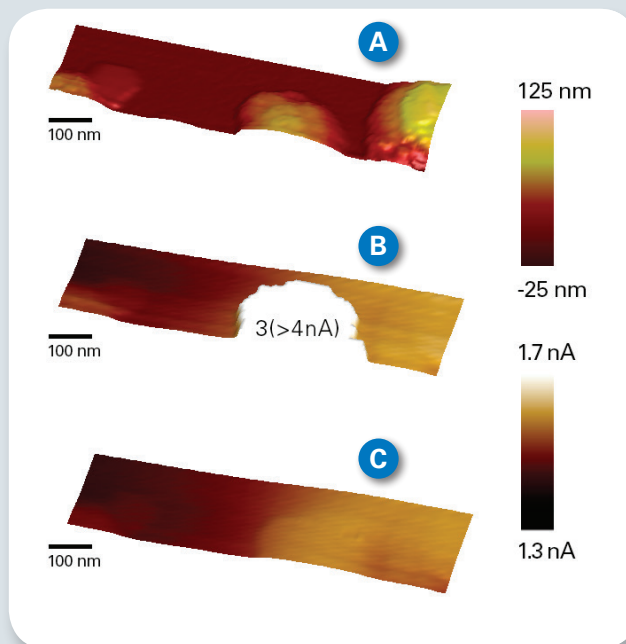


PeakForce SECM images of micro-contact printed CH₃-thiol self-assembled monolayer (SAM) on an Au substrate: (A) topography variations are <1 nm; (B) PeakForce QNM adhesion force; and (C) electrochemical activity at a lift height of 40 nm. (B) and (C) show quantitatively 700 pN and 108 pA differences in adhesion force and electrochemical current, respectively, between the Au and SAM regions. Image courtesy of A. Mark and S. Gödrich, University of Bayreuth.

Simultaneous, High-Resolution Multidimensional Data

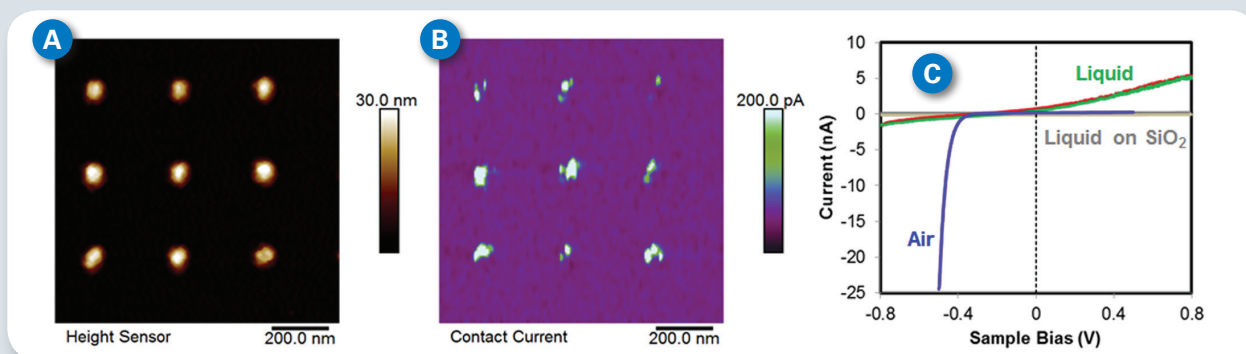
PeakForce SECM provides multidimensional information, allowing correlation of biological, chemical and physical properties with morphological structures at the nanoscale. PeakForce SECM is a breakthrough for modern multidisciplinary research in biological systems, energy devices, catalysis, and corrosion.

PeakForce SECM images of a semiconductor photoelectrode decorated with nanoparticle catalysts. (A) Topography; (B) tip current map during the main scan; and (C) electrochemical current map during the lift scan. 400 pN PeakForce, 0.2 Hz scan rate, 750 nm scan size, 75 nm lift height. Sample image courtesy of J. Jiang, Caltech.



PeakForce TUNA in Liquid

With only the tip apex exposed, the SECM probe is well suited for nanoelectrical measurements in liquid, which can be directly combined with PeakForce modes to simultaneously provide mechanical channels.



PeakForce TUNA™ measurement with the SECM probe in liquid on an array of nanoelectrodes (125 nm diameter and 300 nm period). (A) Topography; (B) contact current; and (C) current-voltage characteristics of nanoelectrodes in air and in an aqueous solution.

PeakForce SECM Specifications

AFM System	Dimension Icon
Compatible Modes	PeakForce Tapping; TappingMode™; Contact; LiftMode™
Probe Type	Premounted cantilever; electrically isolated tip
Exposed Tip Height	150 to 350 nm
Tip ETD	~50 nm
Exposed Tip Materials	Platinum
Passivation	Silicon oxide
Leakage/Capacitive Current	<20 pA at 20 mV/s scan rate
Diffusion-Limiting Current	0.15 to 0.6 nA for 5 mM [Ru(NH ₃) ₆] ³⁺

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