BioLogic

Applications of scanning probe electrochemistry– Catalysis

SCAN-Lab

February 2021

Version 1.0

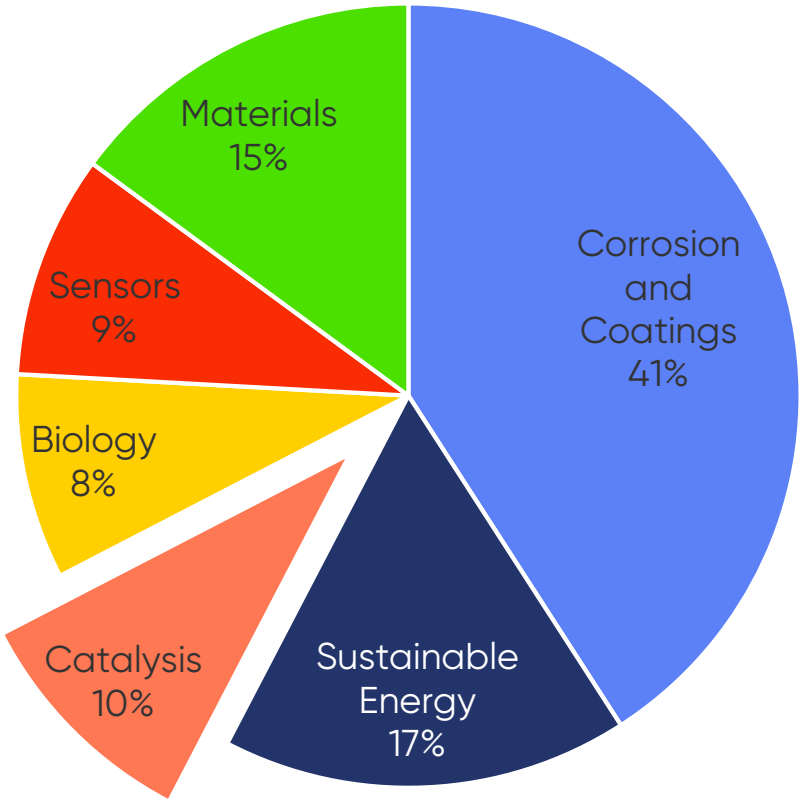
Background

Background

10% of commercial scanning probe electrochemistry instruments are used in catalysis research.

This document will further investigate the role of scanning probe electrochemistry in the field of catalysis.

Publication Fields - All Techniques

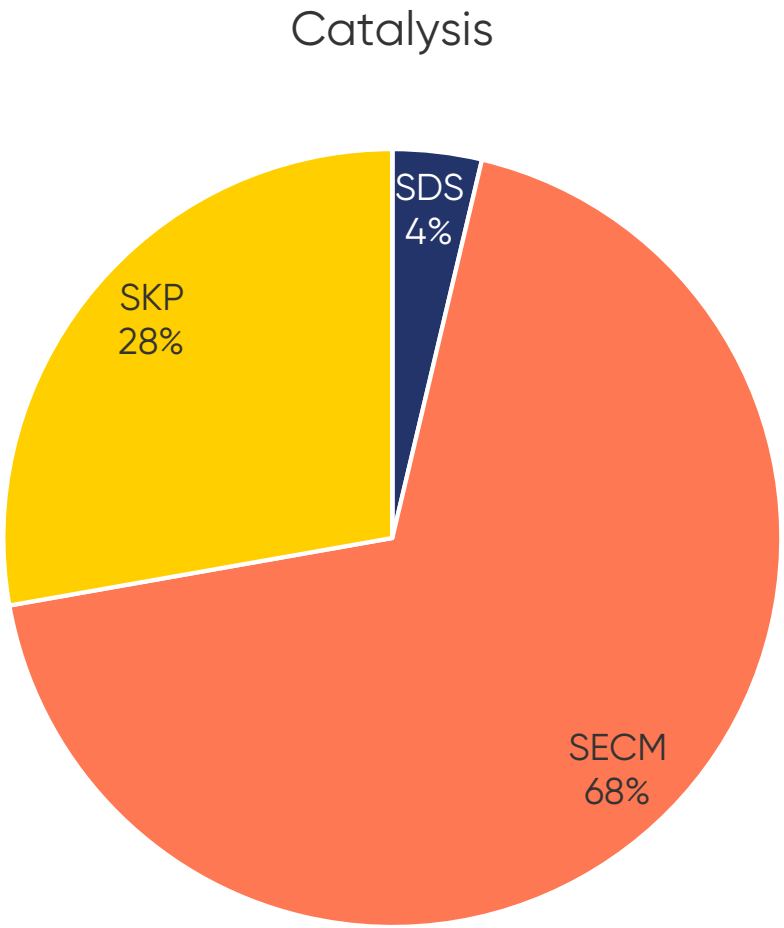


Why is scanning probe electrochemistry applied in catalysis?

Scanning probe electrochemistry is used in fundamental R&D into novel catalytic materials to:

- Screen electrocatalytic activity of individual catalysts and combinatorial libraries
- Investigate the hydrogen evolution reaction at Pt and Pd catalysts
- Screen catalysts for fuel cells

What techniques are used?

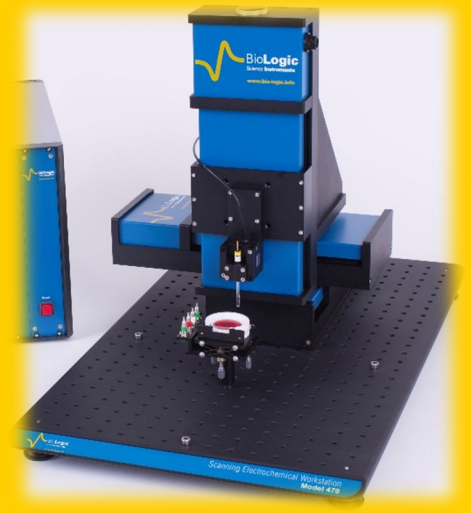


In studies of catalysis SECM is typically applied. SKP, and to a lesser extent SDS have also been applied.

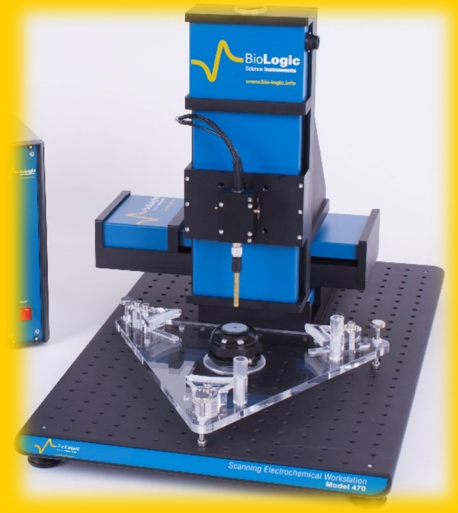
Source: Analysis of scientific publications citing commercial instruments. Each research group was only counted once per technique.

What techniques to consider for catalysis?

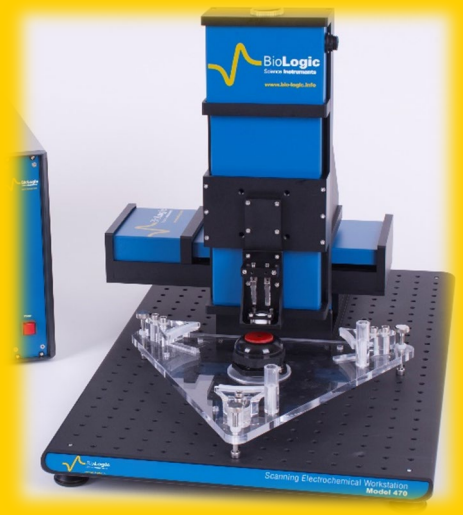
SECM



SKP



SDS



Catalysis

What are the research problems?

The results of bulk electrochemical techniques can be difficult to interpret to determine the local effects on the activity of catalytic materials.

- Solution: Catalytic activity measurement with spatial resolution

***Ex situ* analytical methods for electrocatalysts do not properly reflect their activity in real conditions, i.e. in electrolyte**

- Solution: *In situ* measurement of electrocatalytic activity

Individual screening of numerous catalyst compositions can be incredibly time consuming.

- Solution: A method to quickly screen electrocatalysts

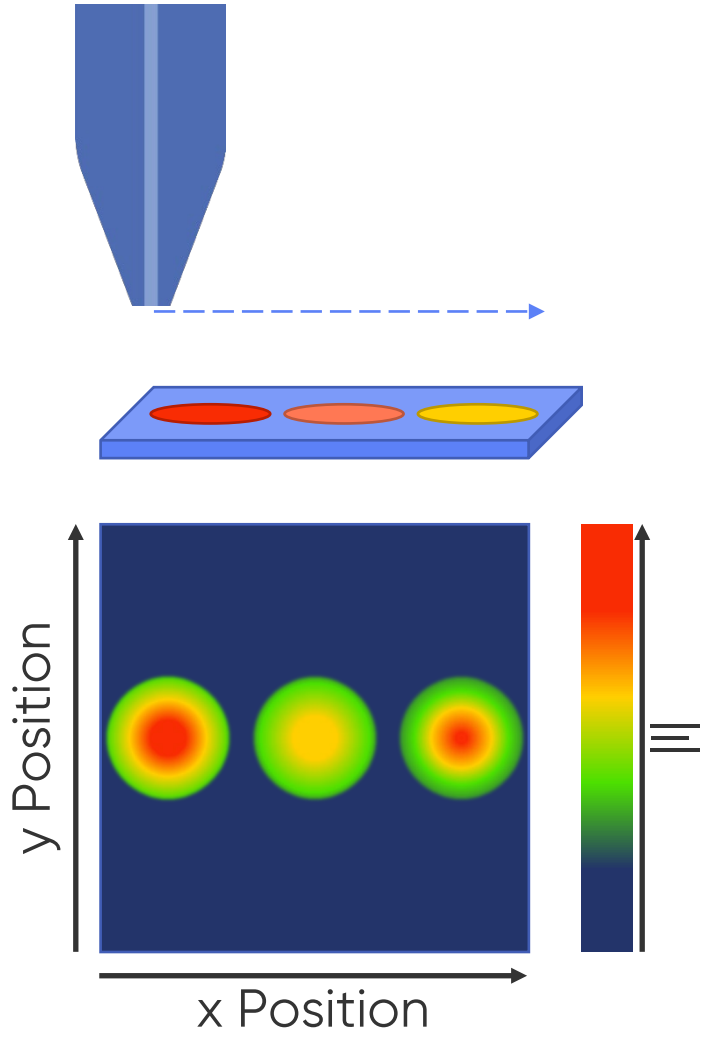
Solution: Catalytic activity measurement with spatial resolution

How this is met by scanning probe electrochemistry:

Bulk techniques measure an average of the bulk catalyst. Data can be difficult or impossible to interpret to obtain information related to local effects on catalytic activity.

In scanning probe electrochemistry only the area under the probe is measured, providing local data. The electrochemical characteristics measured relate to a sample's catalytic activity. By raster scanning the probe across the sample a map of catalytic activity is produced.

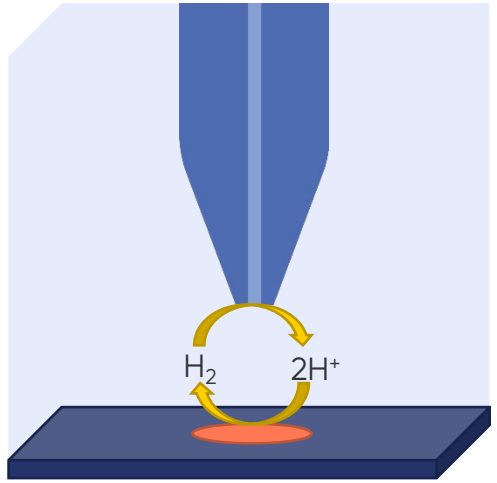
Users can select from a range of probe sizes, or use homebuilt probes, to meet their resolution needs.



Solution: *In situ* measurement of electrocatalytic activity

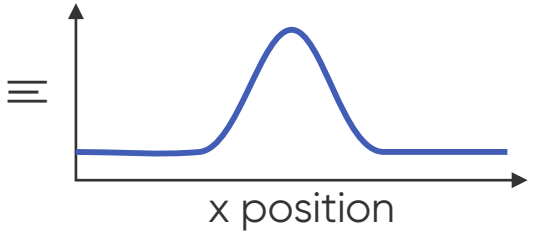
How this is met by scanning probe electrochemistry:

A key feature of many scanning probe electrochemistry techniques is that they are performed in electrolyte. This means the ability to perform *in situ* measurements is integral to the technique to allow electrocatalytic activity to be investigated under real world conditions.



Typically these studies are performed in aqueous electrolytes with good compatibility with BioLogic's scanning probe instruments.

Users concerned about chemical compatibility should contact their BioLogic representative for information on materials used.



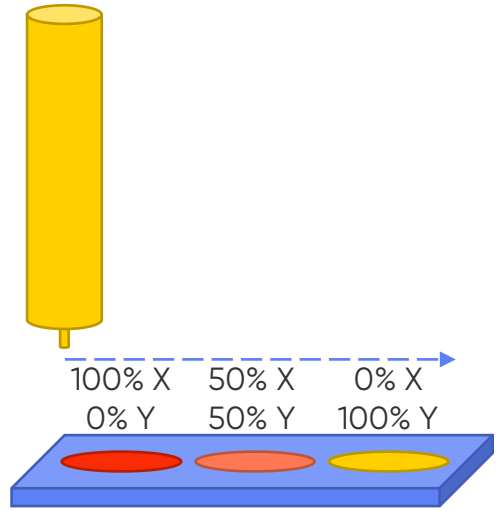
Solution: A method to quickly screen local catalytic activity

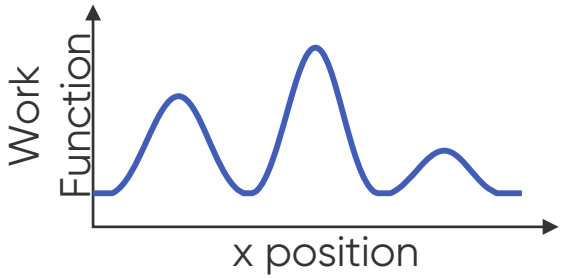
How this is met by scanning probe electrochemistry:

Scanning probe electrochemisty can be used to quickly screen the activity of combinatorial libraries of electrocatalysts without the need to change samples or experimental setup. This greatly reduces the time required compared to traditional electrochemical screening methods.

This fast screening sees scanning probe electrochemistry used as an initial investigation to determine compositions which should be focused on for further study.

Note the final experiment length will be related to the number of samples and size of the scan area.





Conclusions

Summary

- Scanning probe electrochemistry can be used in catalysis studies to measure the local catalytic activity.
- Scanning probe electrochemistry has the ability to perform experiments *in* situ, as required by many catalysis studies.
- In catalysis research SECM is of the most interest, with SKP and SDS also used.

Why SCAN-Lab?

The scanning probe electrochemistry instruments available from BioLogic allow the visualization of local catalytic activity *in situ*. BioLogic offers the most diverse range of techniques on a single platform, allowing a range of characteristics of electrocatalytic materials to be measured. This expands the current and future research avenues available from a single instrument.

Learning Center Article

A series of Learning Center articles has been created to help determine the most appropriate technique for a given research problem. This includes an article dedicated to catalysis research:

Scanning Probes & Catalytic Systems

Acronyms

- SECM: Scanning ElectroChemical Microscopy
- SKP: Scanning Kelvin Probe
- SDS: Scanning Droplet System. Scanning Droplet Cell (SDC) also used.