Nanoscale Redox Imaging

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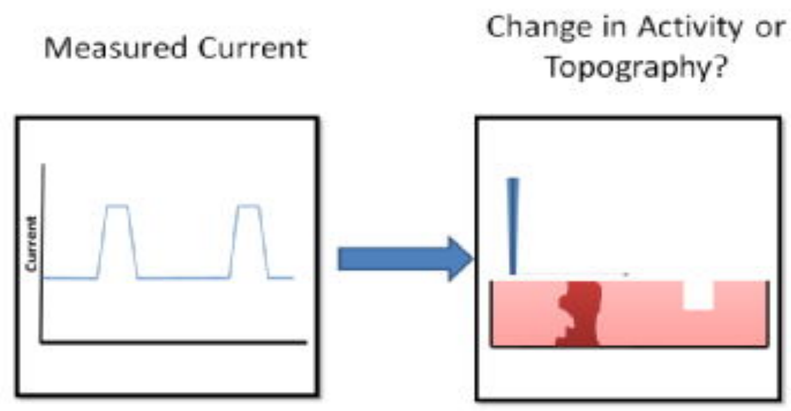
1 – INTRODUCTION

Intermittent Contact Scanning ElectroChemical Microscopy (IC-SECM) is a new method of *scanning probe microscopy* that introduces distance control into conventional *scanning electrochemical microscopy* by integrating electrodes into *atomic force microscopy*. This overcomes the problem of unambiguously determining changes in surface topography and activity by oscillating the nanoelectrode at a fixed amplitude, and using amplitude damping as a feedback parameter to keep the tip a fixed distance from the surface.(1) The **goal of the project** is to introduce nanoelectrodes into IC-SECM to greatly enhance the spatial resolution.

Fig. 1: Are changes in measured current due to topography or activity changes at the substrate in conventional SECM?



2 – NANOELECTRODES

Nanoelectrodes were made by sealing a platinum wire inside a capillary, and pulling under a laser puller to create a long, thin taper. This taper was then polished back to give a tip of the required size of 200-300 nm diameter.

Fig. 2: Platinum electrode, as viewed under an optical microscope

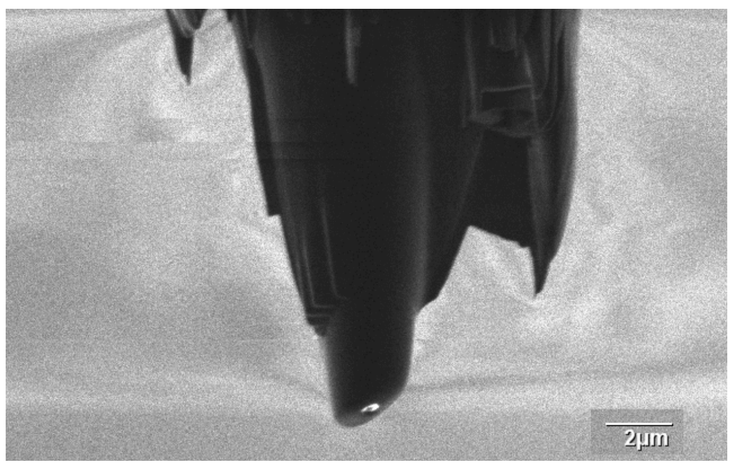
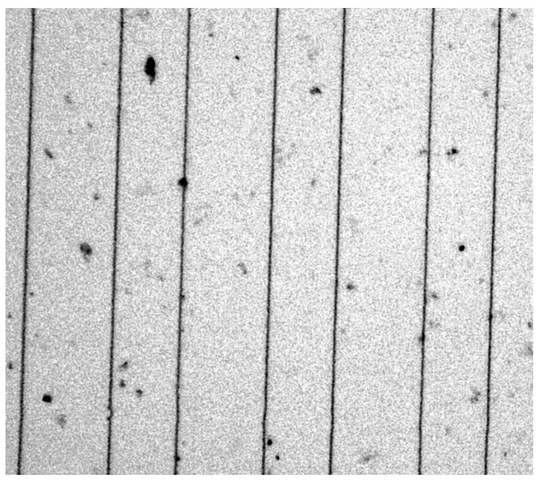


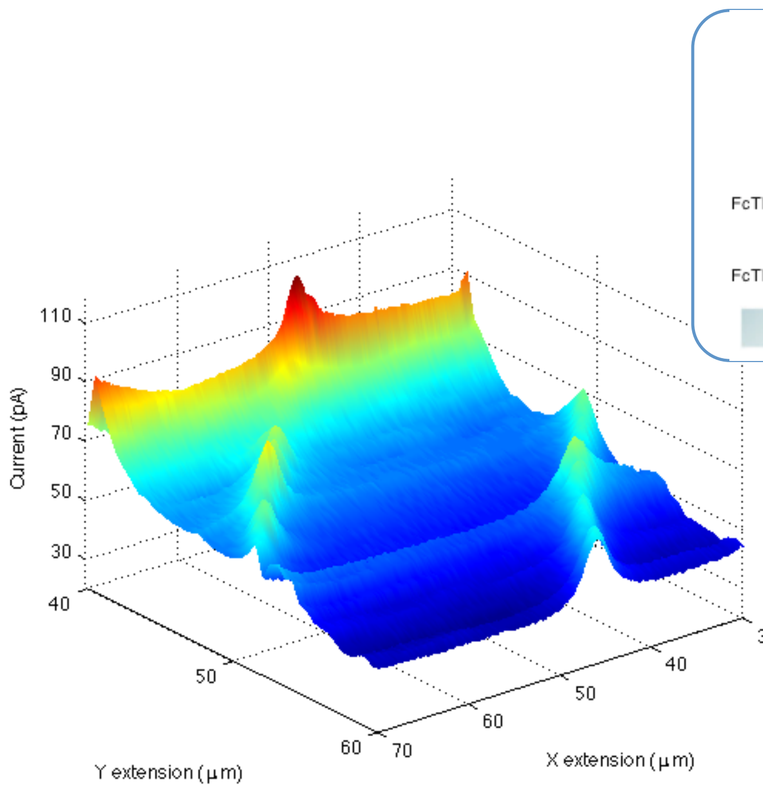
Fig. 3: Platinum electrode, as viewed under a scanning electron microscope. Scale bar indicates a tip size of approximately 400 nm diameter.

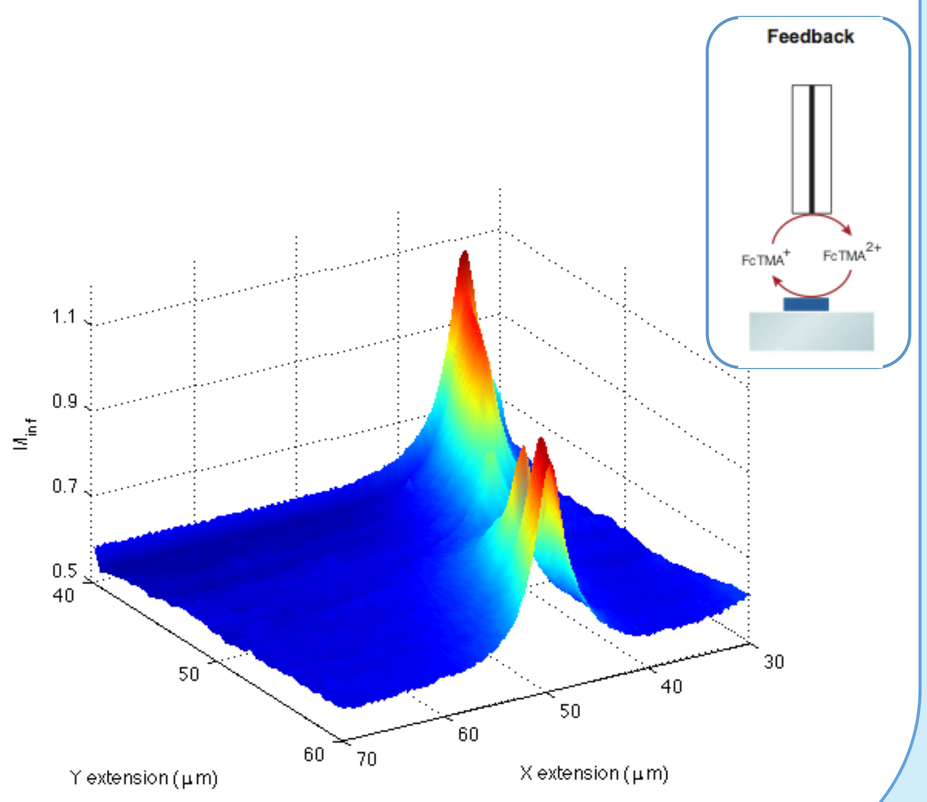
3 – IMAGING

Fig. 4: Optical microscope image of nanowires



Figs. 5a&b: Small scale (40x20µm) scan of nanowires, in substrate generation-tip collection mode (left), and feedback mode (right)





4 – CONCLUSIONS AND FURTHER WORK

Nanoelectrodes have successfully been used to image hard surfaces with IC-SECM. Future work involves studying whether the transition to soft surfaces is feasible, whether by varying the amplitude and frequency of tip oscillation to get the required damping, or by using other parameters such as phase.

5 – REFERENCES

(1): K. McKelvey M.A. Edwards, and P.R. Unwin: *Intermittent Contact-Scanning Electrochemical Microscopy (IC-SECM): A New Approach for Tip Positioning and Simultaneous Imaging of Interfacial Topography and Activity*, Anal. Chem. 2010, 82, 6334-6337

6 – ACKNOWLEDGEMENTS

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