

# Deconvolution in Scanning Electrochemical Microscopy

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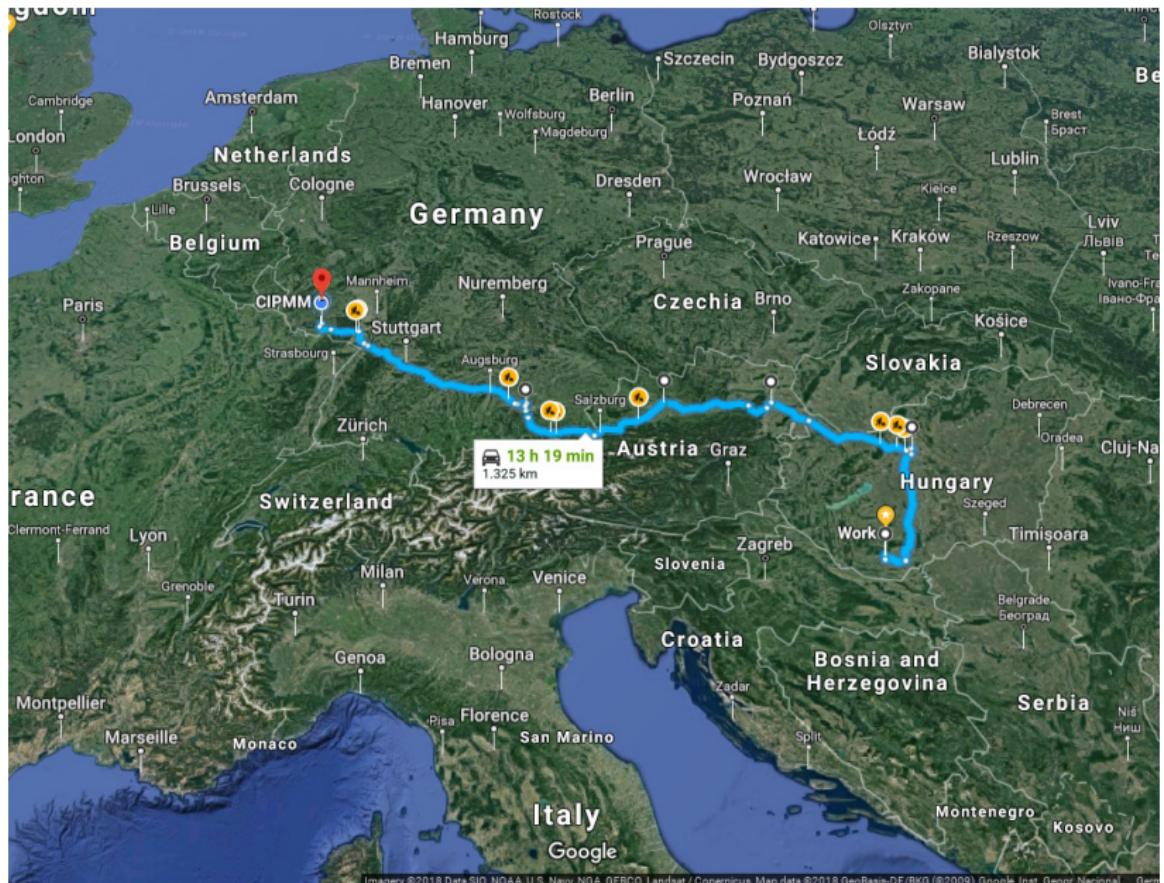
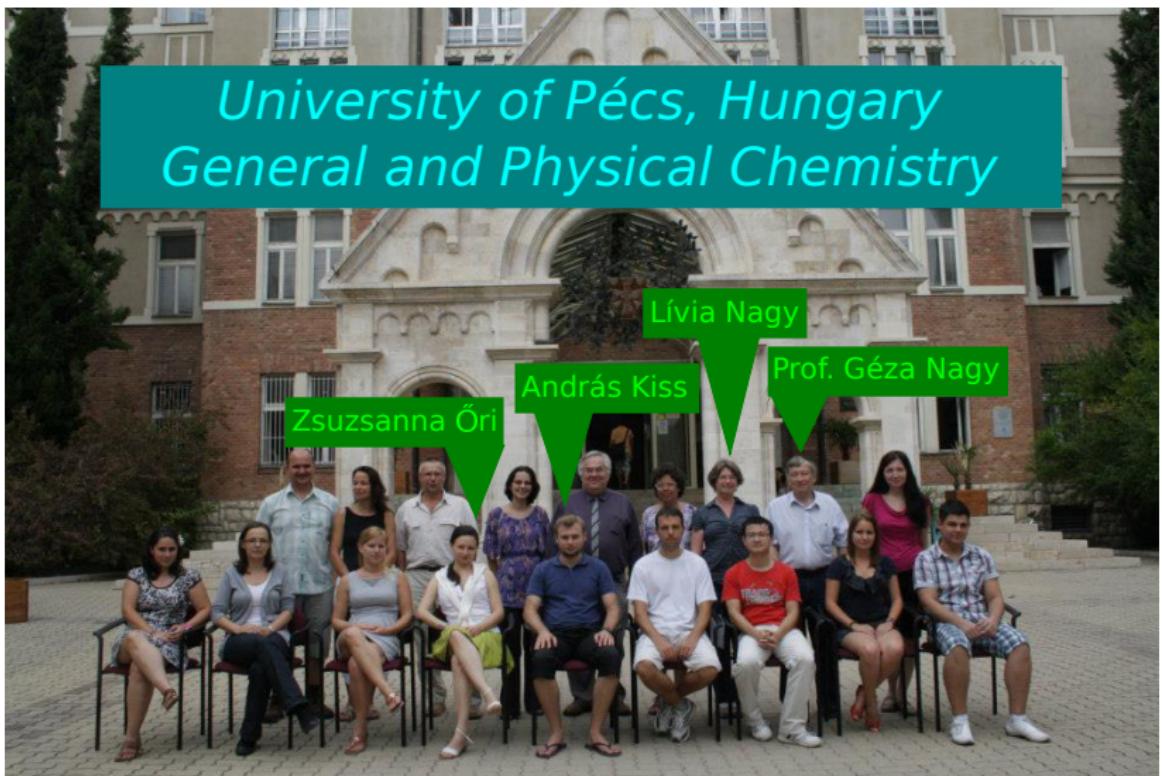


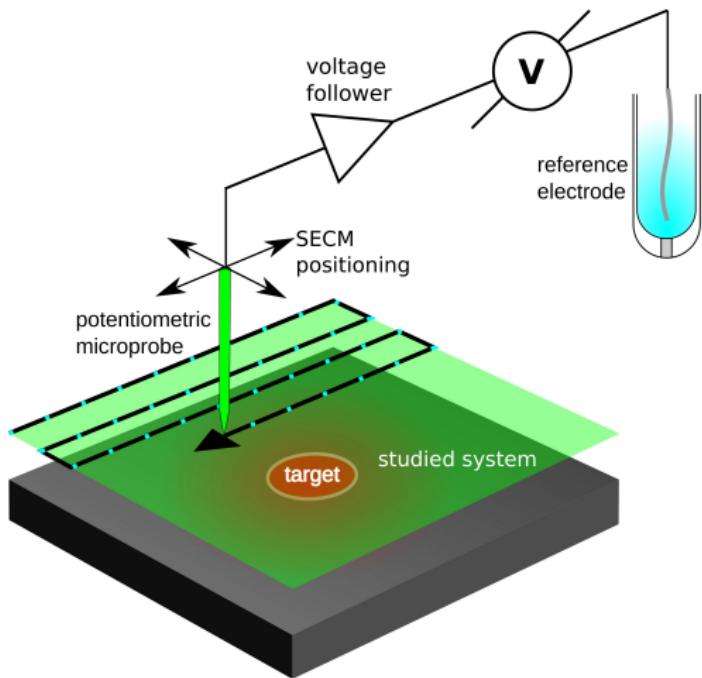
Image courtesy of NOAA/NESDIS/NGDC. Last updated: 2018-06-29T12:00:00Z

# *University of Pécs, Hungary General and Physical Chemistry*

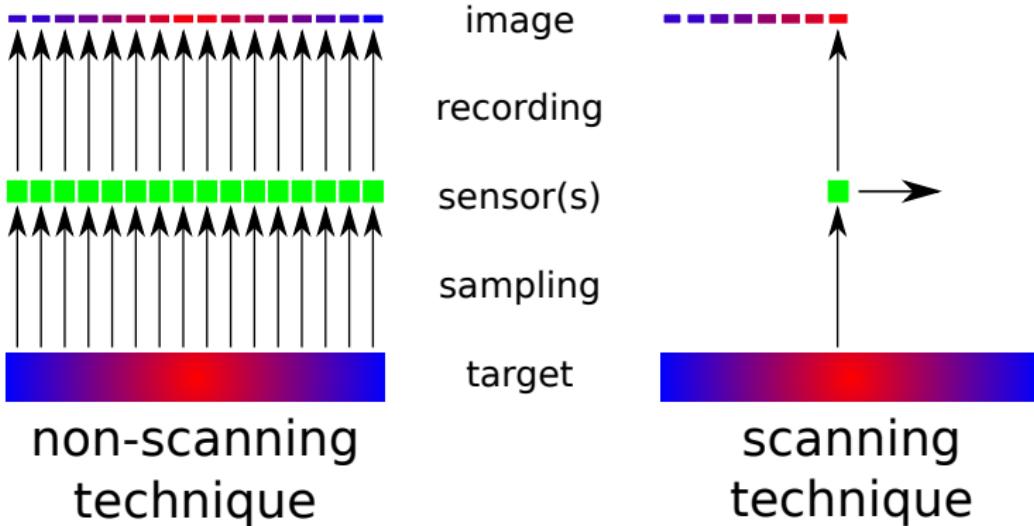


# Potentiometric Scanning Electrochemical Microscopy

A Scanning Probe Microscopic technique

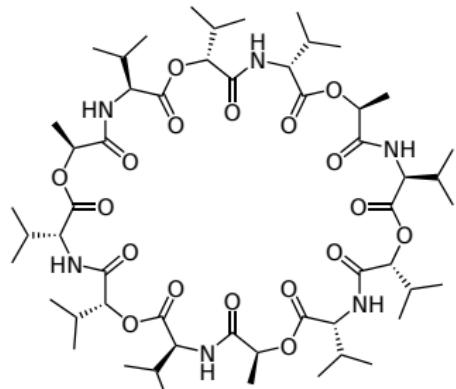
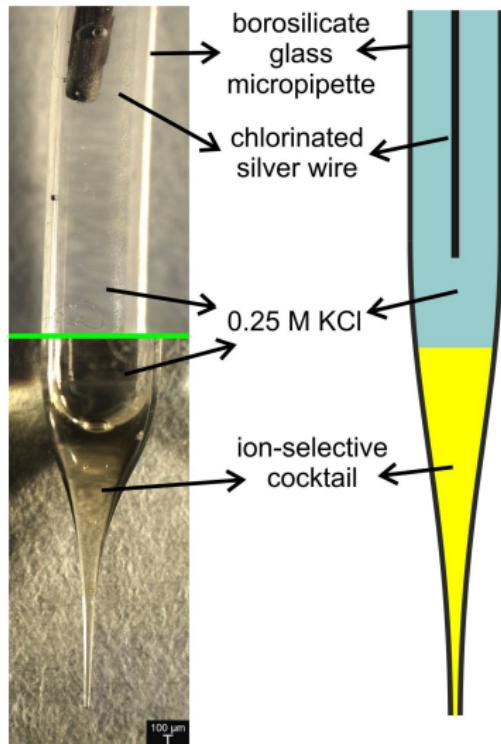


# Difference between conventional and scanning microscopic techniques



# Ion-selective micropipettes

As SECM probes



Valinomycin

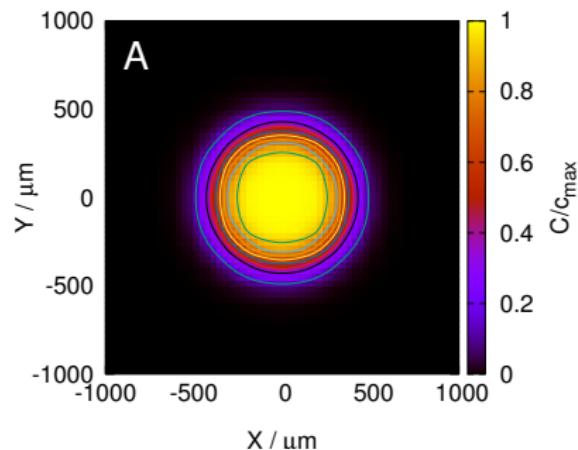
$$E = E^\theta + \frac{RT}{z_i F} \ln \left[ a_i + \sum_j \left( k_{ij} a_j^{z_i/z_j} \right) \right]$$

Nikolsky-equation

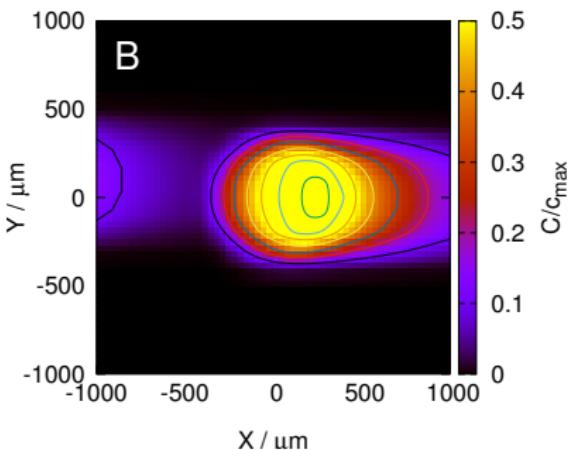
# The problem with potentiometric SECM

Distortion at high scan rate

Slow

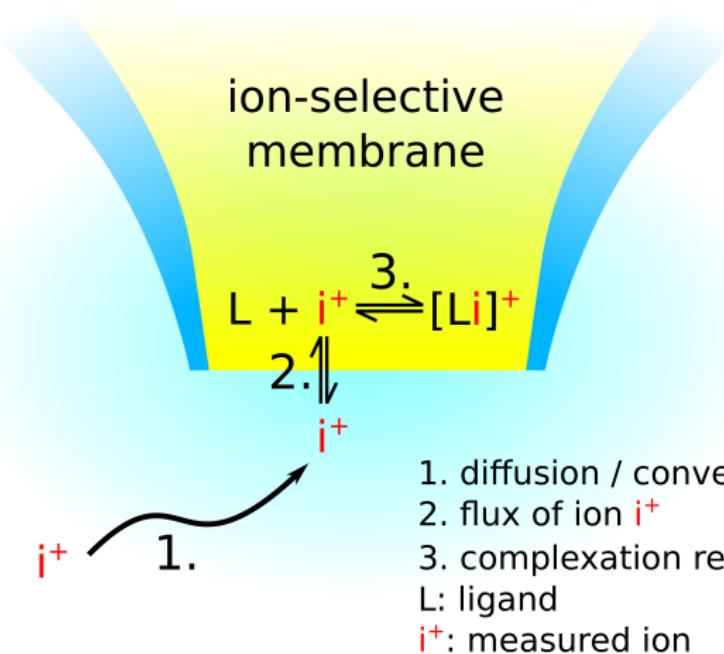


Fast



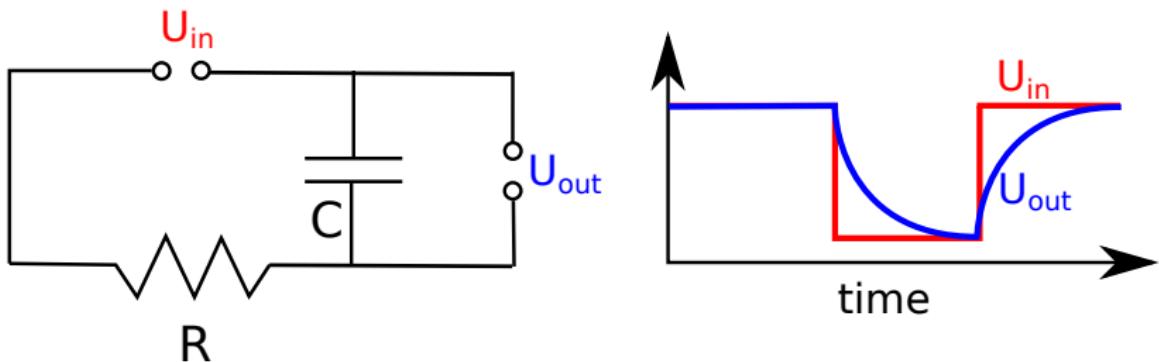
# Why is the image distorted?

Possible contributors to the lag



# Why is the image distorted?

The RC time constant



The time that is required to charge the capacitor by  $\approx 63\%$  ( $1 - 1/e$ ).

$$\tau = R \cdot C$$

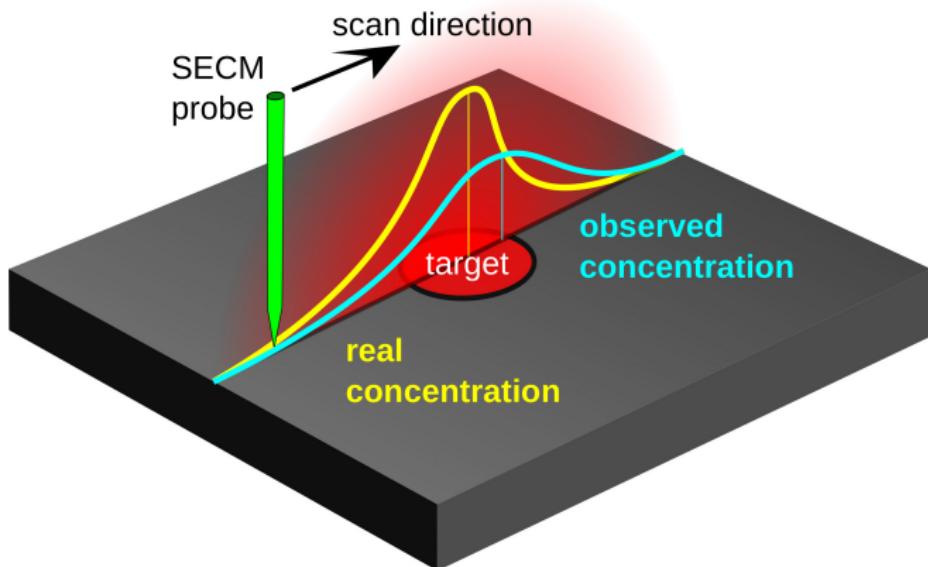
$$R = 5 \text{ G}\Omega$$

$$C = 500 \text{ pF}$$

$$\tau = 2.5 \text{ s}$$

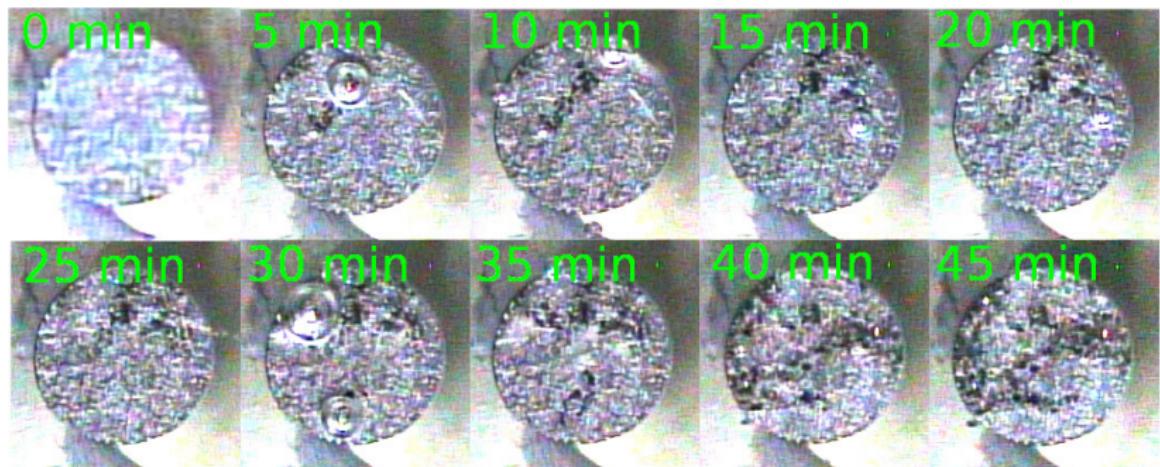
# Distortion of potentiometric imaging

In the case of a linescan



# Why is it so important to complete the scan quickly?

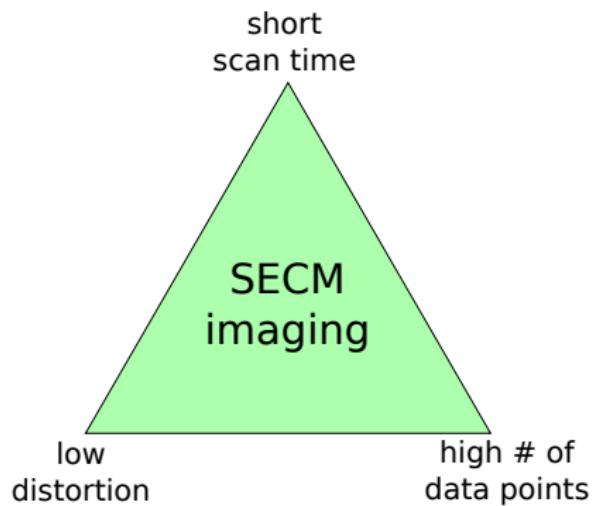
Example: corrosion of a magnesium alloy



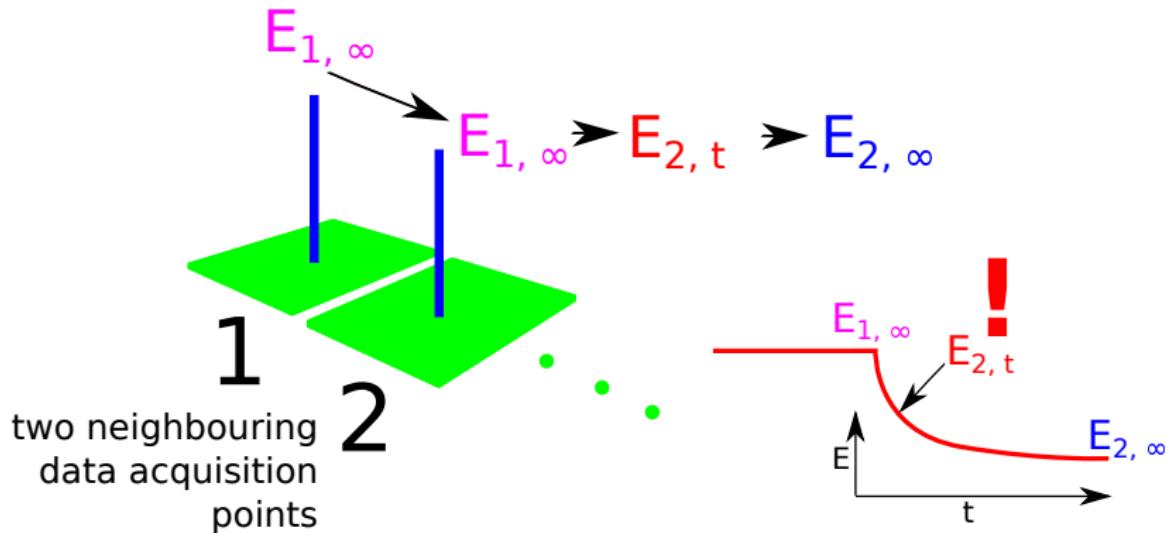
Corrosion of the AZ63 magnesium-aluminium-zinc alloy.

# Trade-off triangle of potentiometric SECM

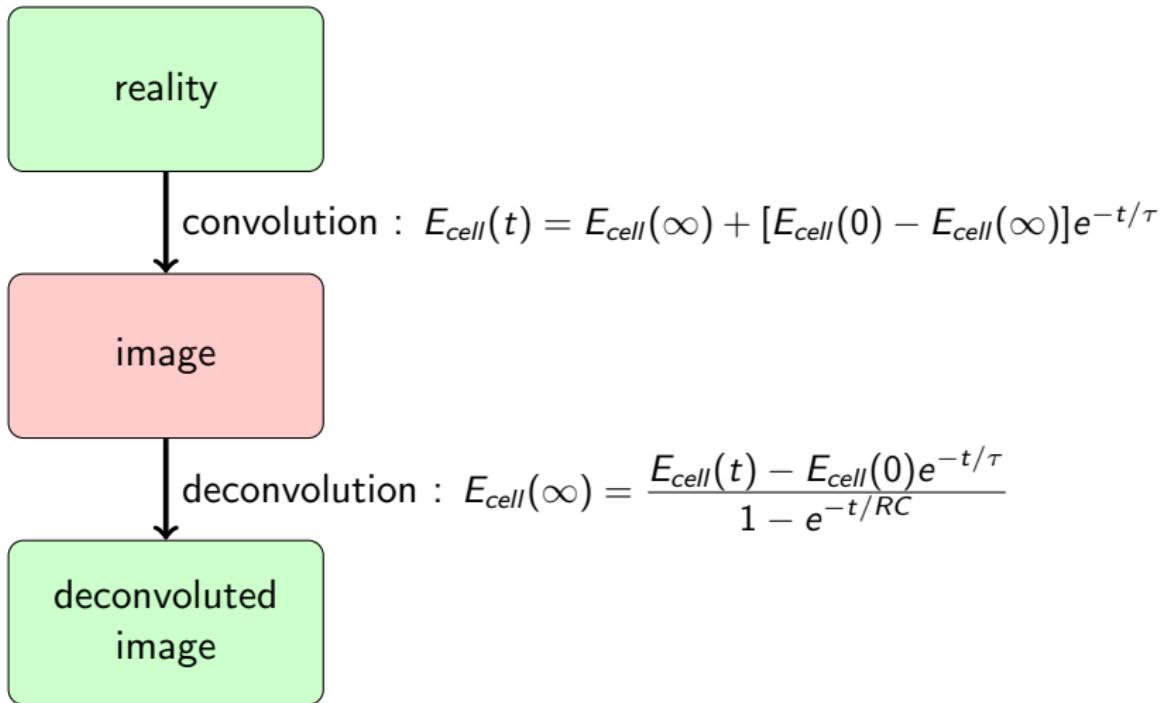
Compromise between the three desired competing properties



## The convolution function of the distortion

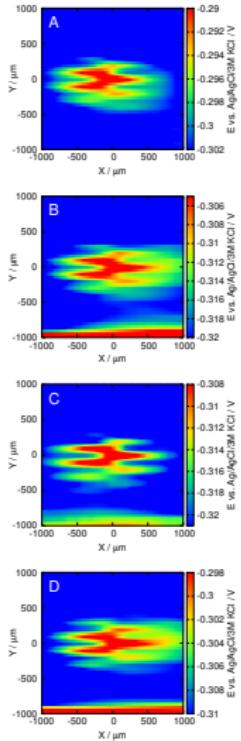


# Convolution and deconvolution

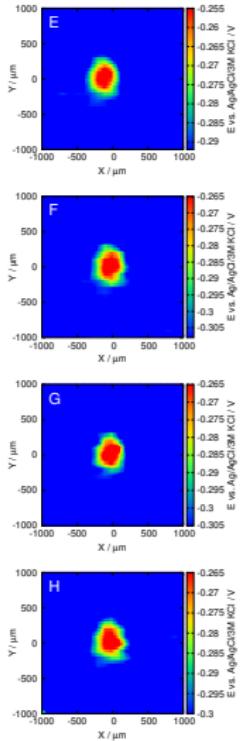


# Deconvolution of potentiometric SECM images

Recorded using the antimony microelectrode following the meander algorithm

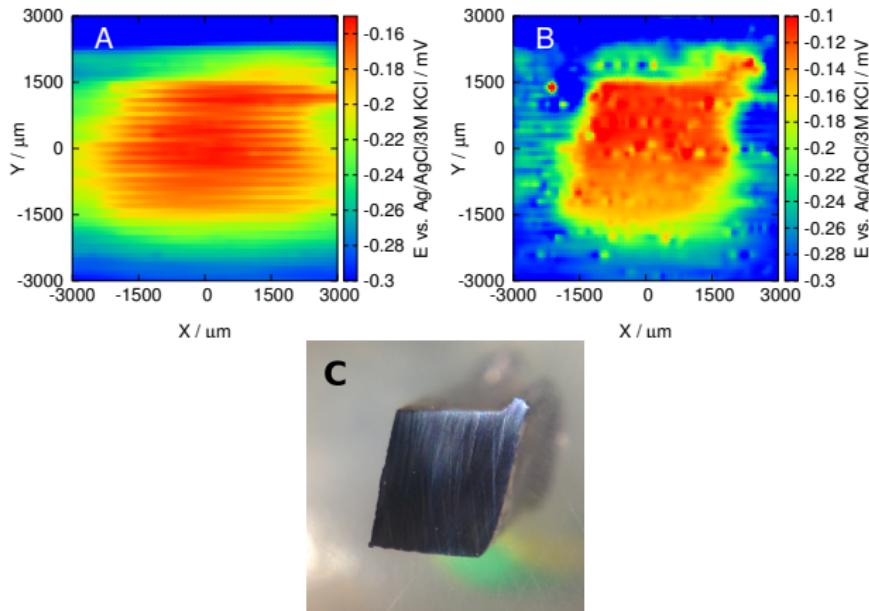


deconvolution  
→



# Practical example: corroding carbon steel sample

Scanned with an antimony microelectrode



# 9th Workshop on Scanning Electrochemical Microscopy and Related Techniques

Warsaw, Poland, August 13-17, 2017.

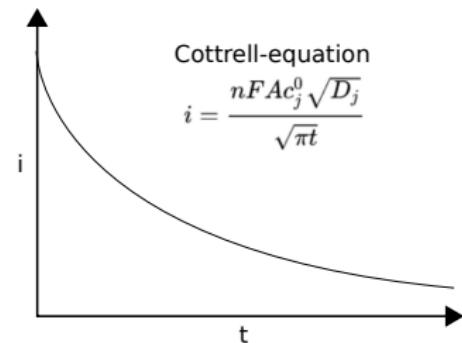
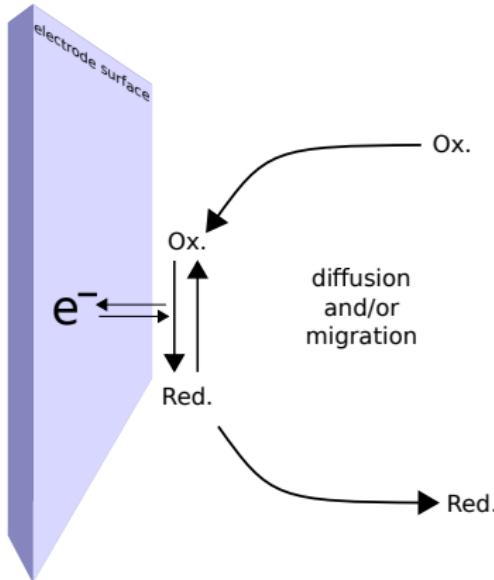


Can it be done with amperometric SECM images?

# DAAD

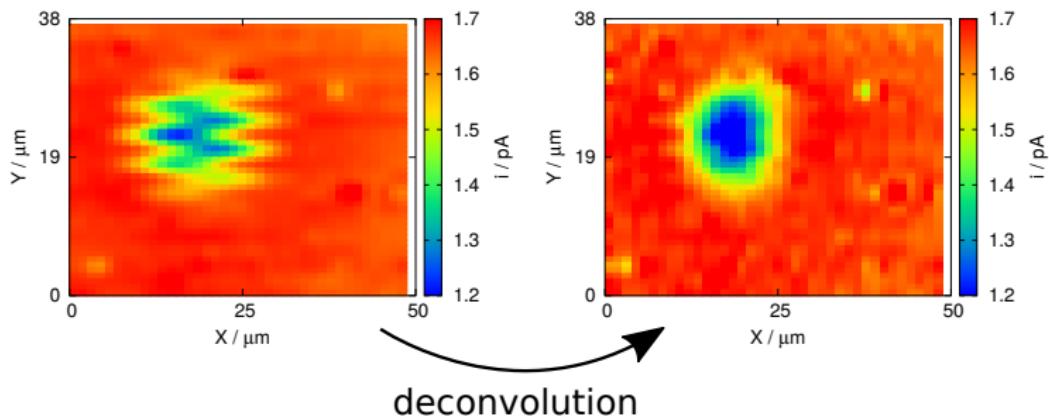
Deutscher Akademischer Austausch Dienst  
German Academic Exchange Service

# Amperometric transient response



# Deconvolution of an amperometric image.

$\text{H}_2\text{O}_2$  oxidation current above a monocyte exposed to  $\text{H}_2\text{O}_2$ .



# Conclusion