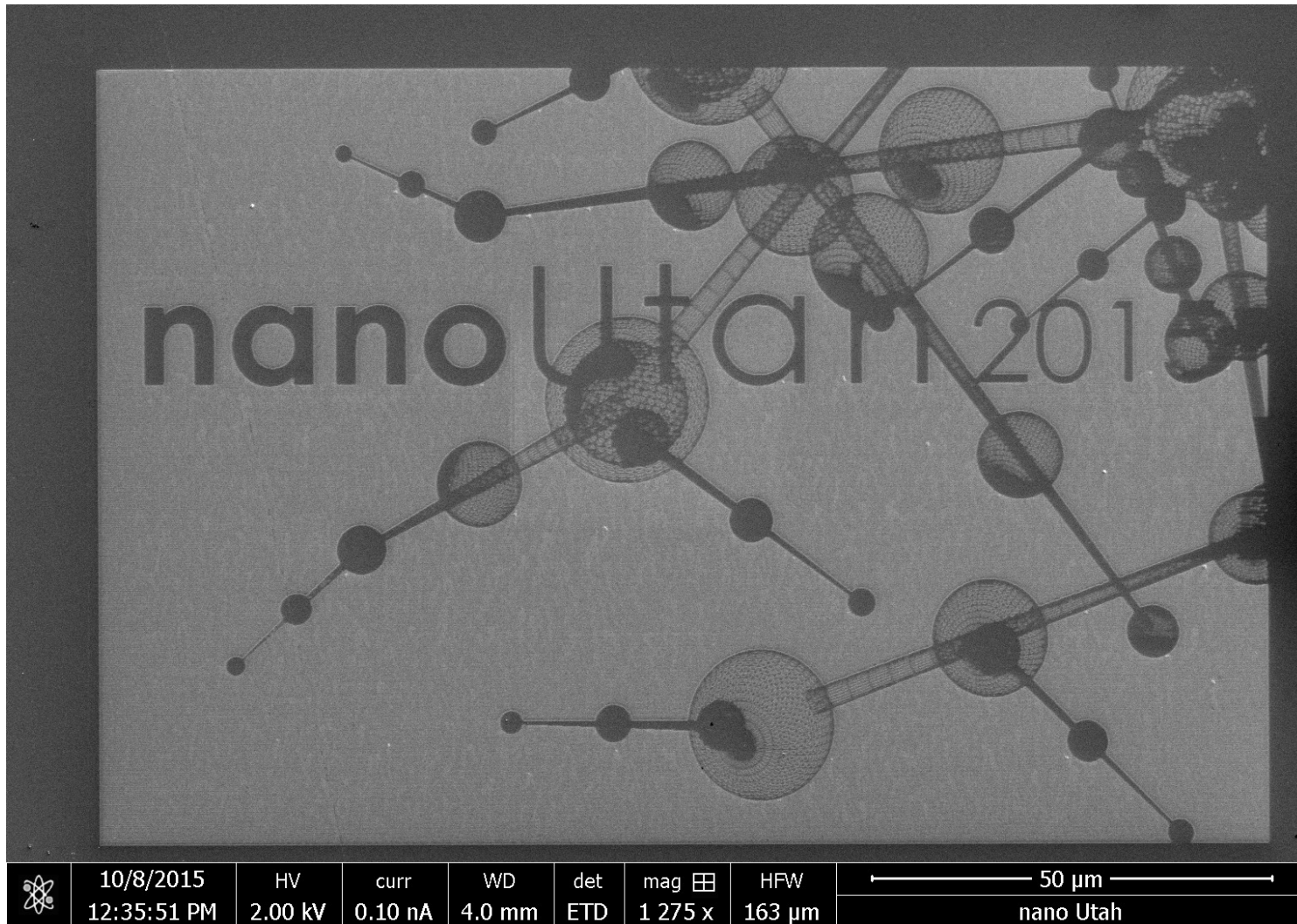
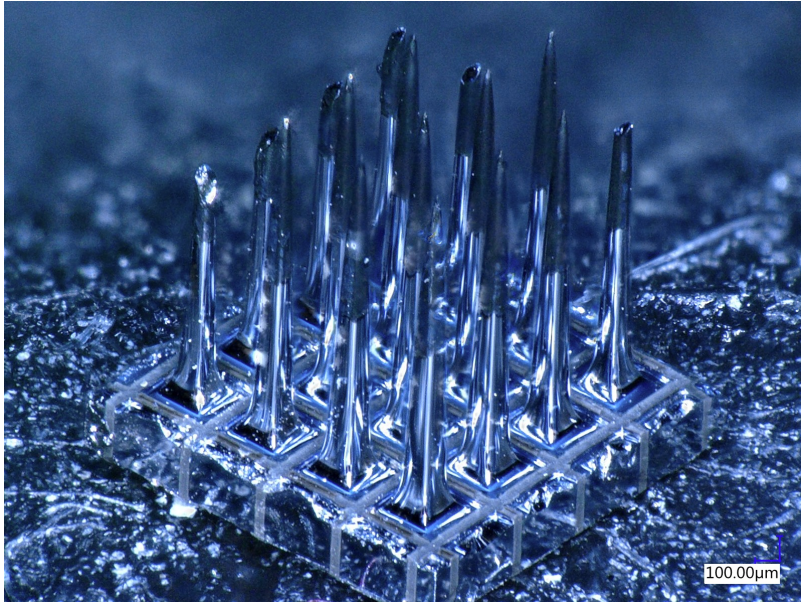


# Multiscale correlative microscopy

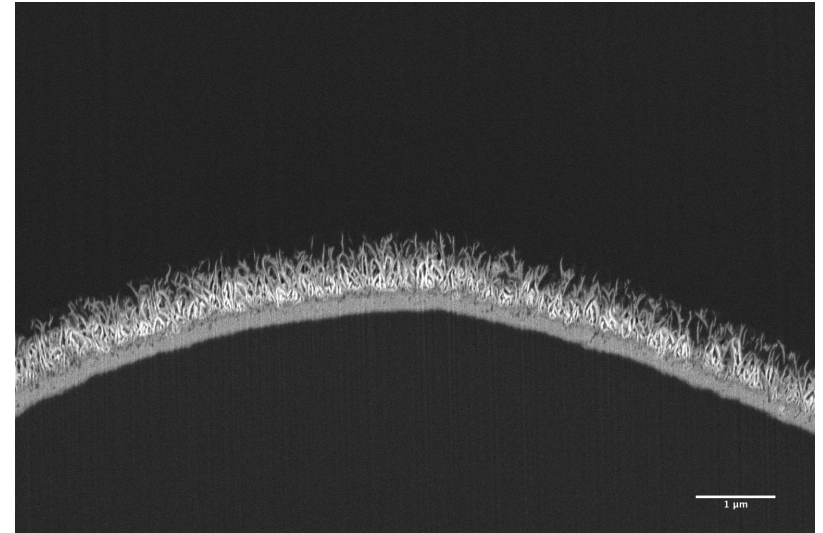
Randall Polson, Ph.D  
Surface Analysis Lab, NanoFab  
University of Utah Engineering



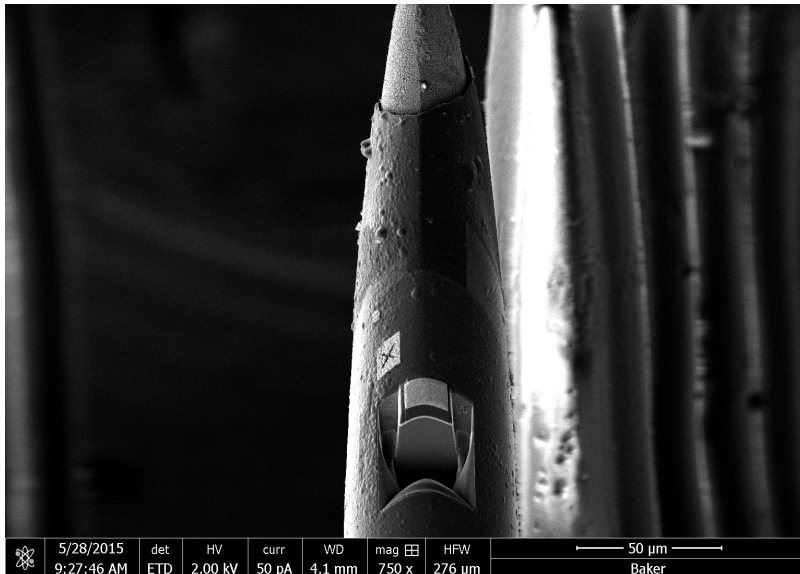
# Different tools, different views



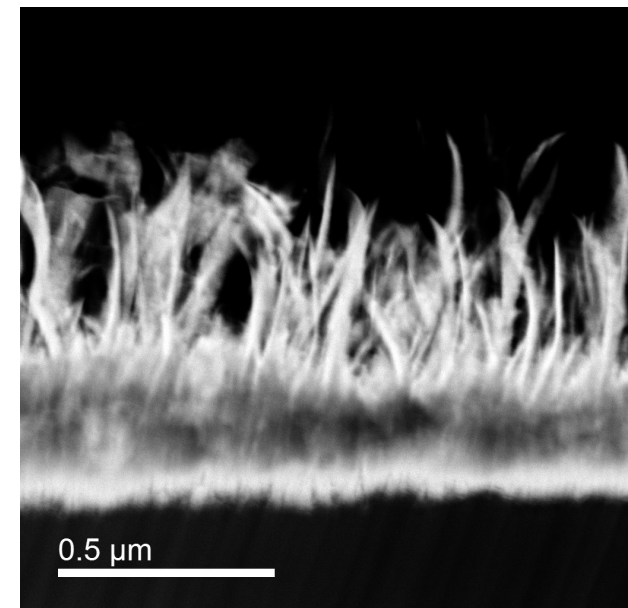
**Optical** 0.5 pixels/micron  
Image size 3200 x 2400 micron



**SEM** 150 pixels/ micron  
Image size 10x6 micron

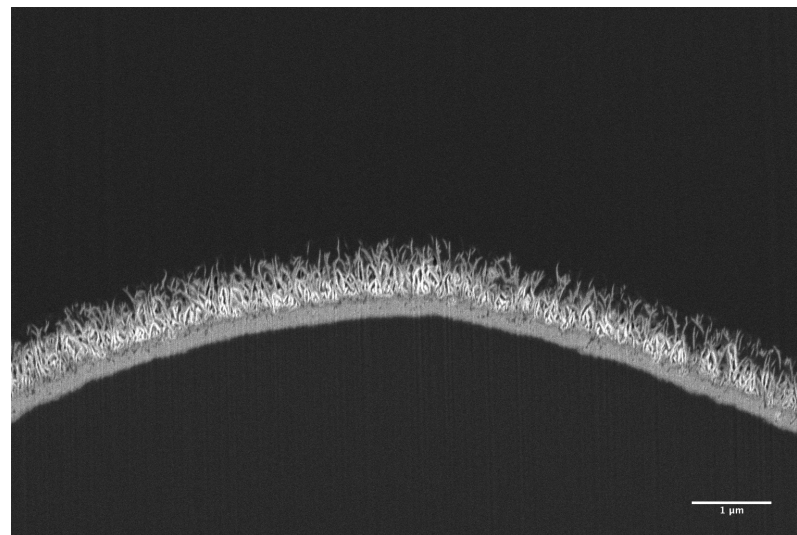
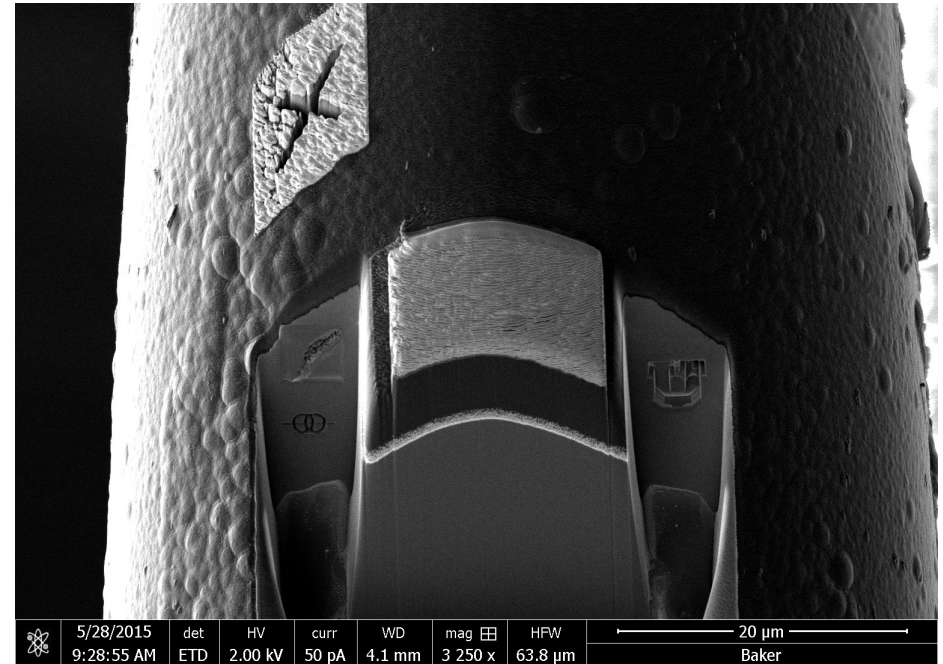
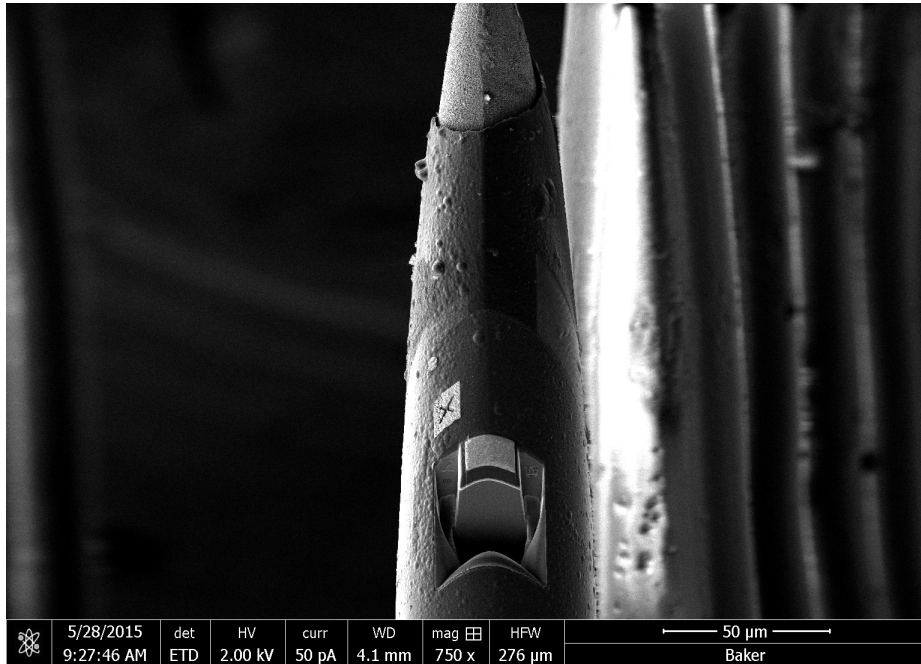


**SEM** 5.6 pixels/ micron  
Image size 270x195 micron

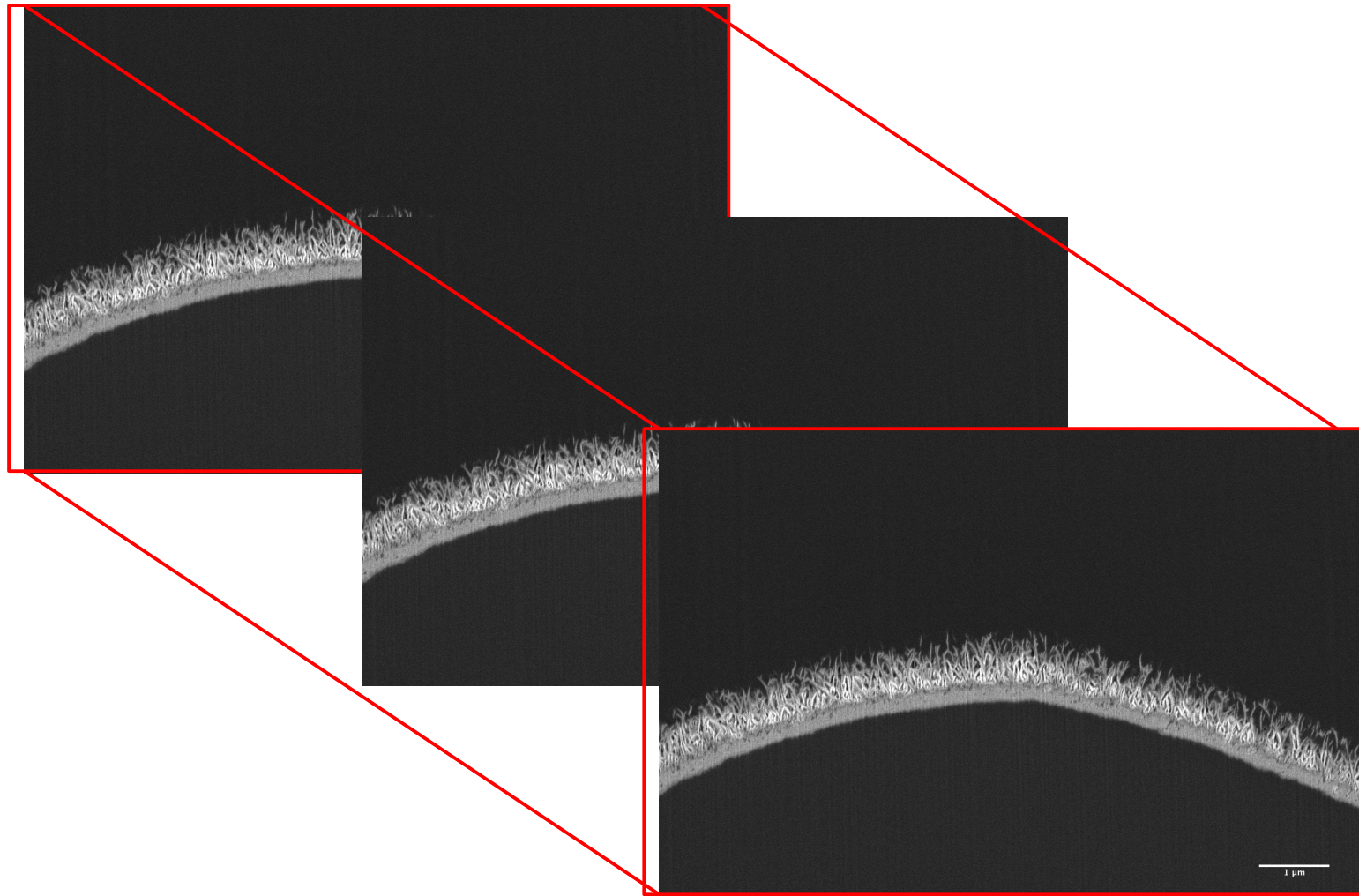


**STEM** 728 pixels/ micron  
Image size 1.4x1.4 micron

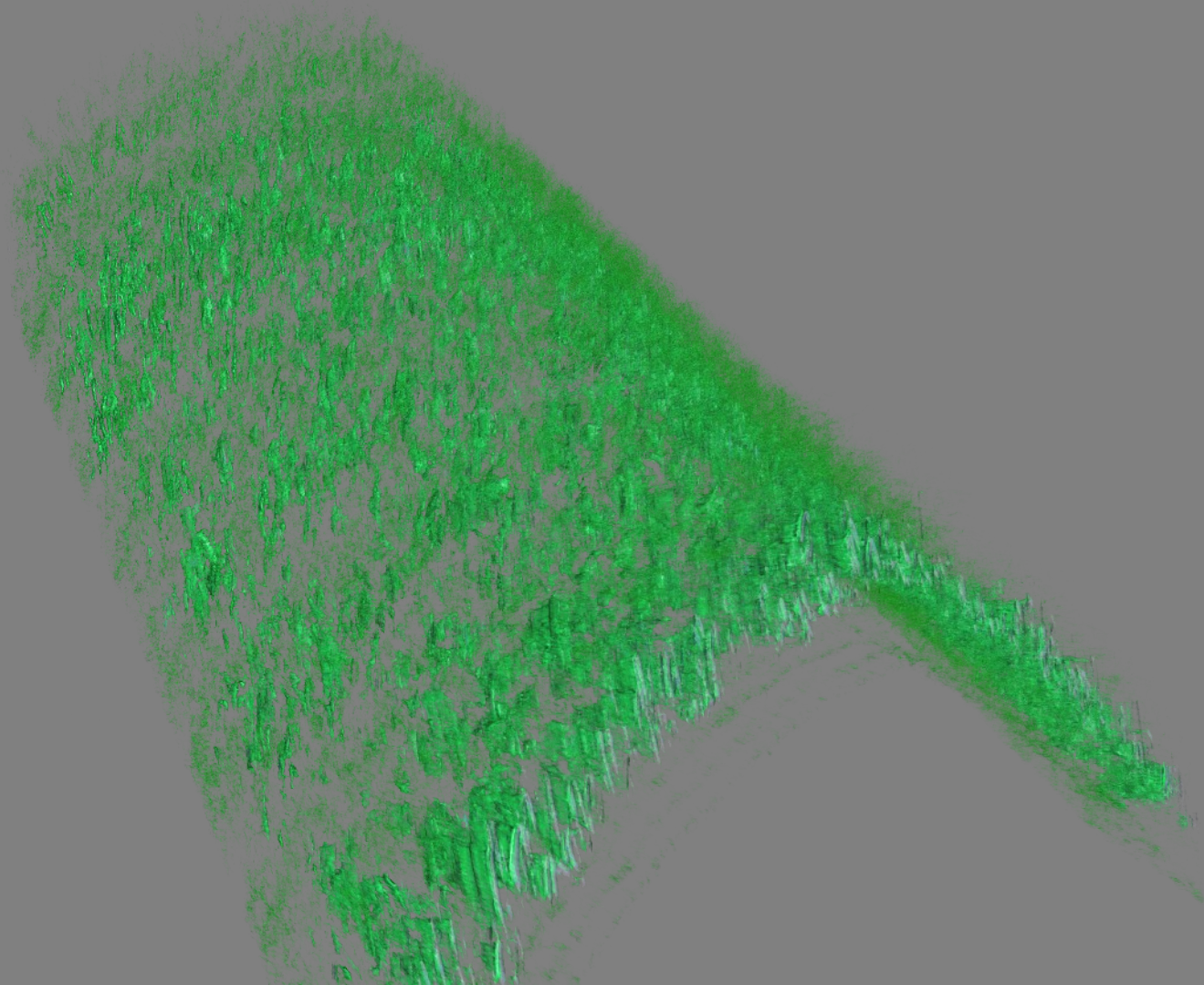
# FIB cuts and SEM images



# Successive FIB slices

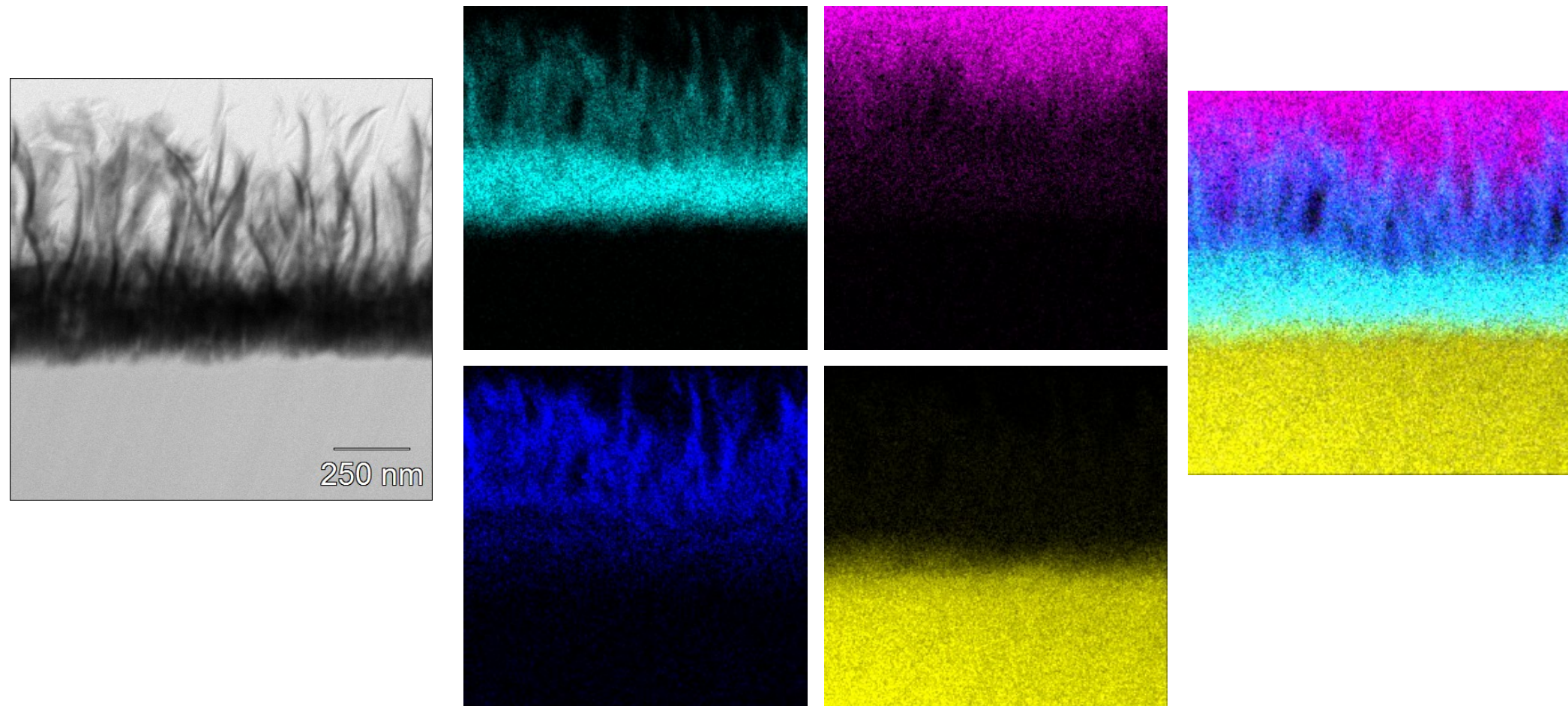


# Volume reconstruction

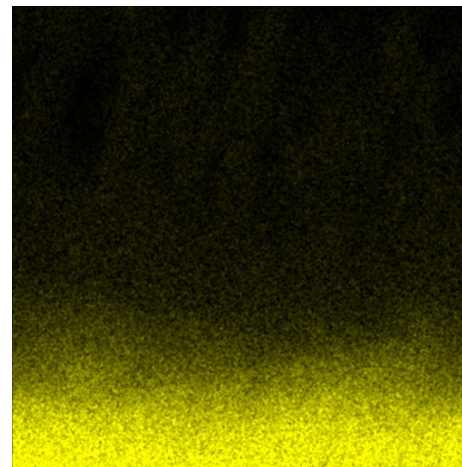
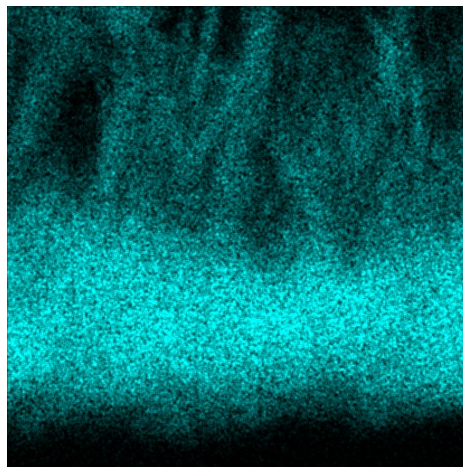
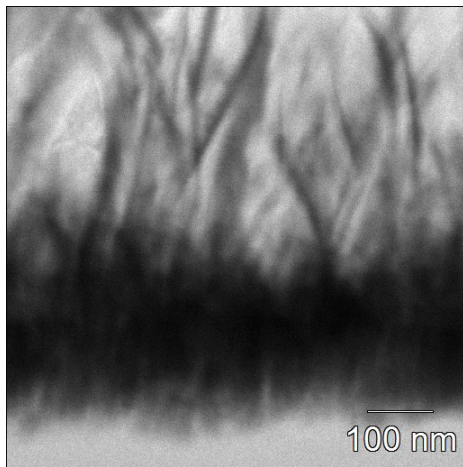


# STEM elemental mapping

TEM image (grey)  
Iridium map (cyan)  
Oxygen map (blue)  
Carbon map (magenta)  
Silicon map (yellow)

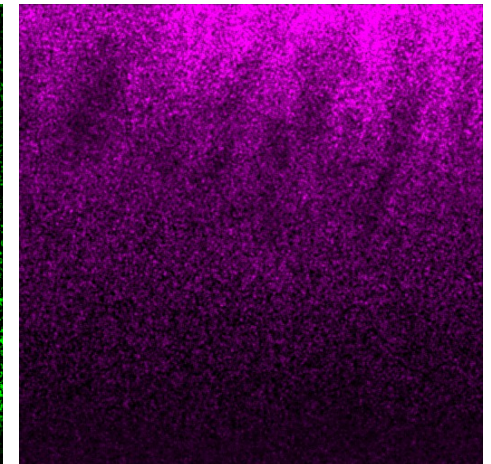
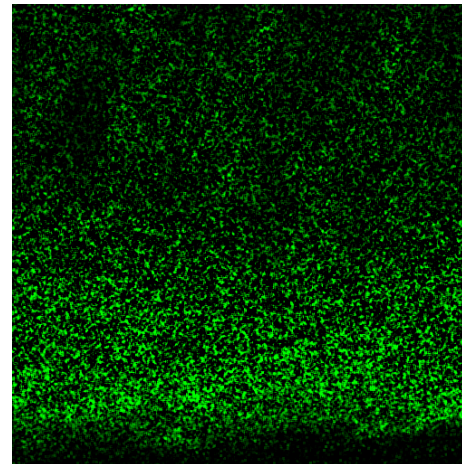
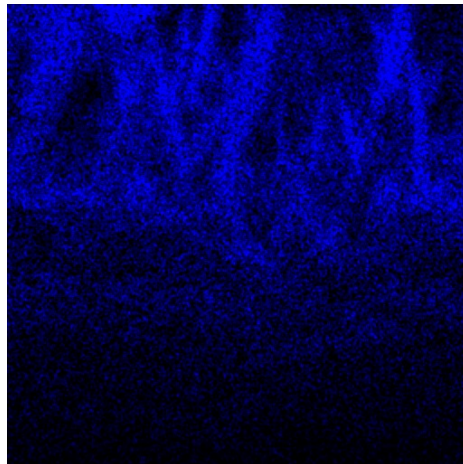


# Higher resolution mapping



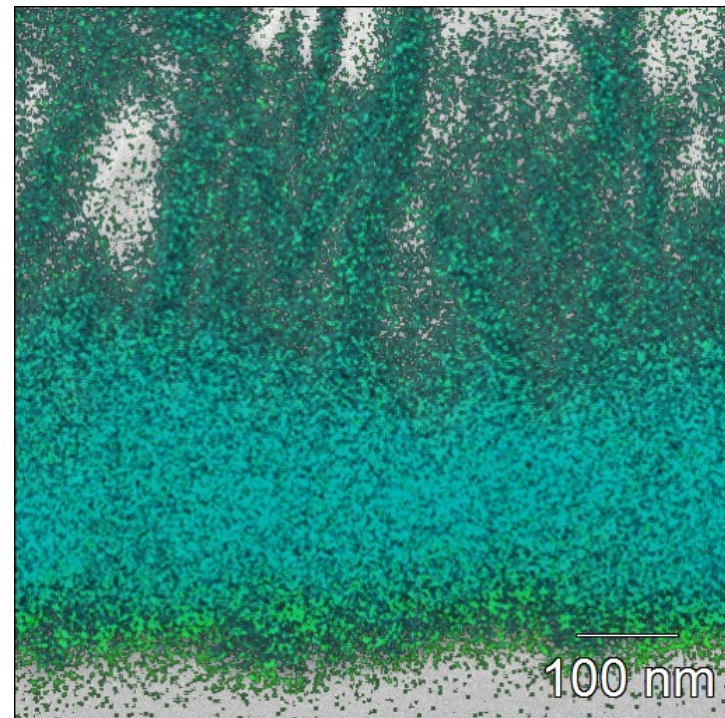
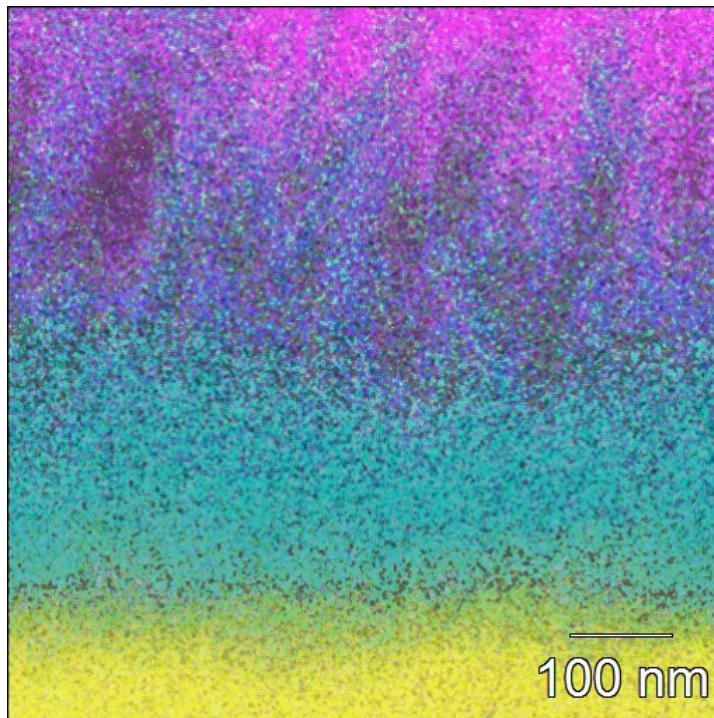
TEM image (grey)  
Iridium map (cyan)  
Platinum(green)  
Oxygen map (blue)  
Carbon map(magenta)  
Silicon map(yellow)

TEM image (grey)  
Iridium map (cyan)  
Platinum(green)  
Oxygen map (blue)  
Carbon map(magenta)  
Silicon map(yellow)



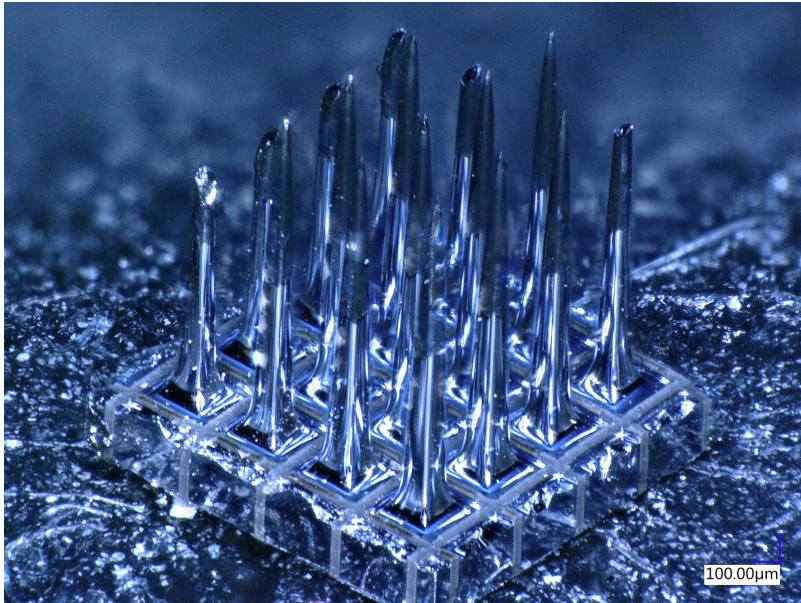
# Higher resolution overlay

TEM image (grey)  
Iridium map (cyan)  
Platinum (green)  
Oxygen map (blue)  
Carbon map (magenta)  
Silicon map (yellow)

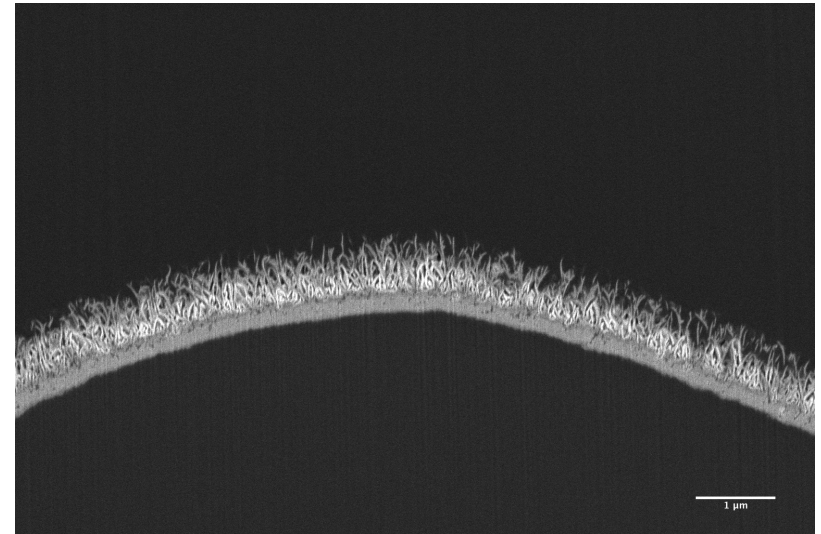




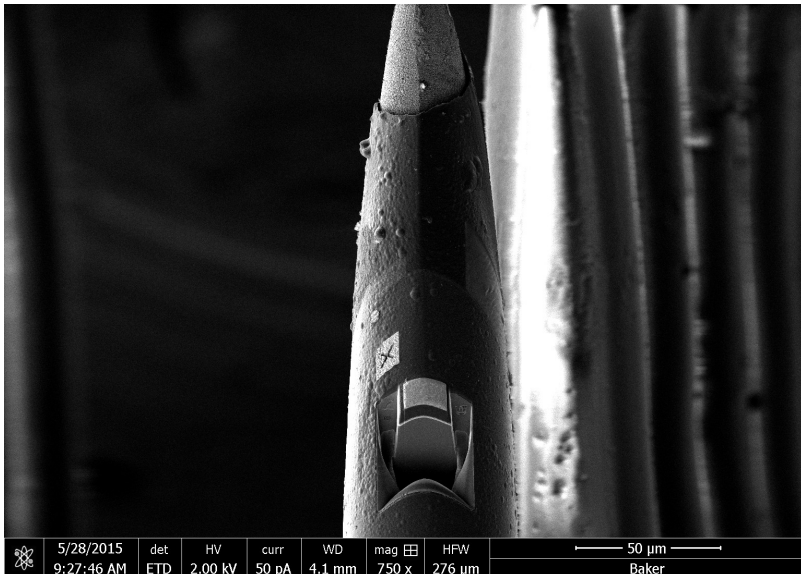
# Different tools, different scales



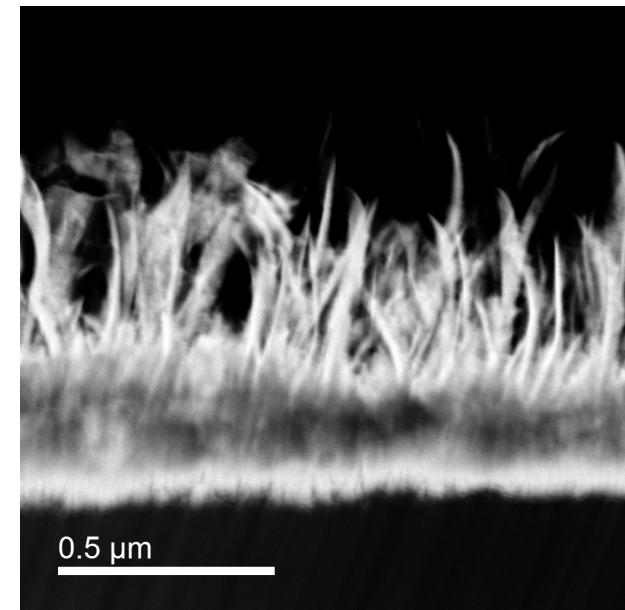
Optical **0.5 pixels/micron**  
Image size 3200 x 2400 micron



SEM **150 pixels/ micron**  
Image size 10x6 micron

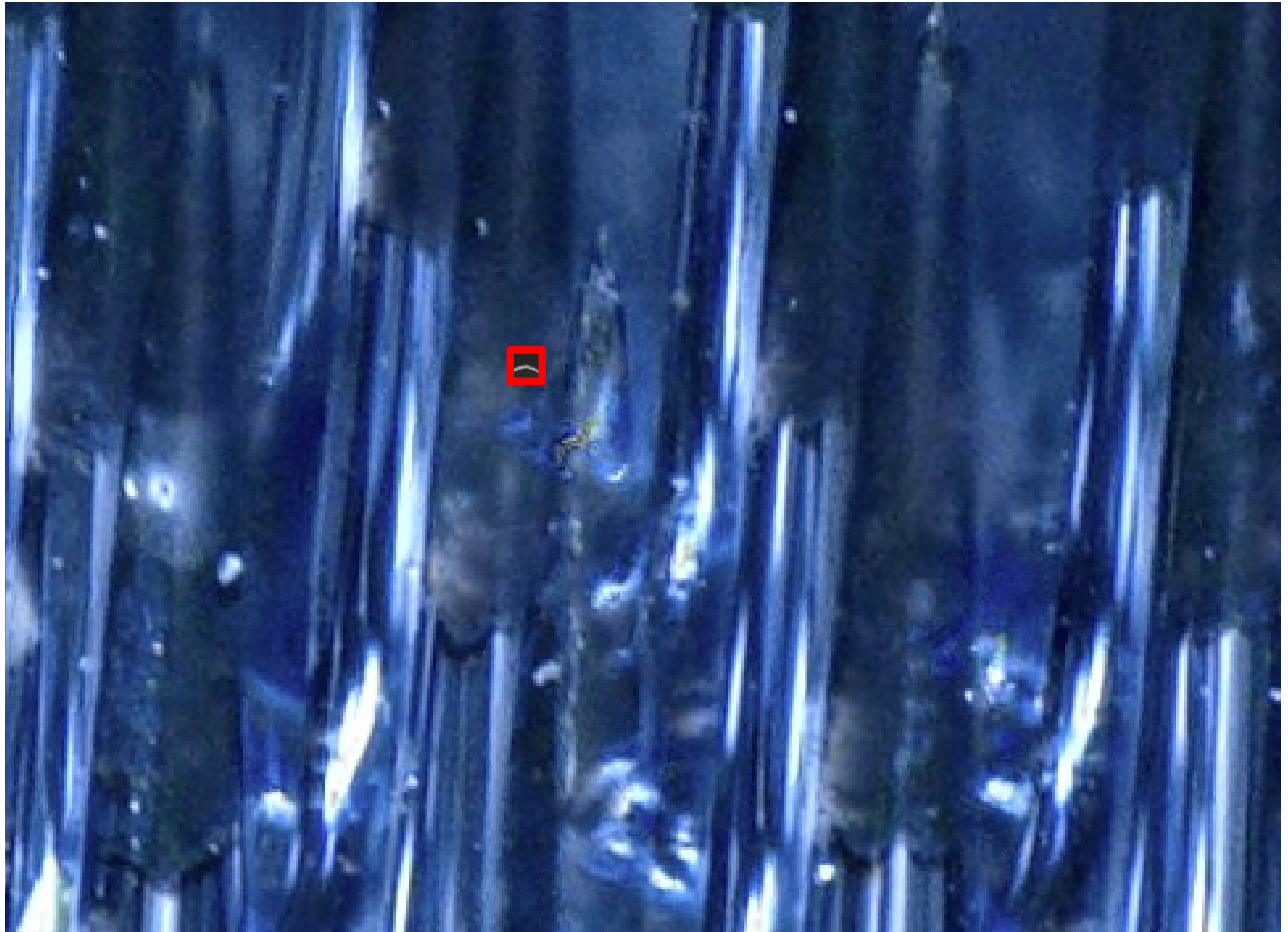


SEM **5.6 pixels/ micron**  
Image size 270x195 micron



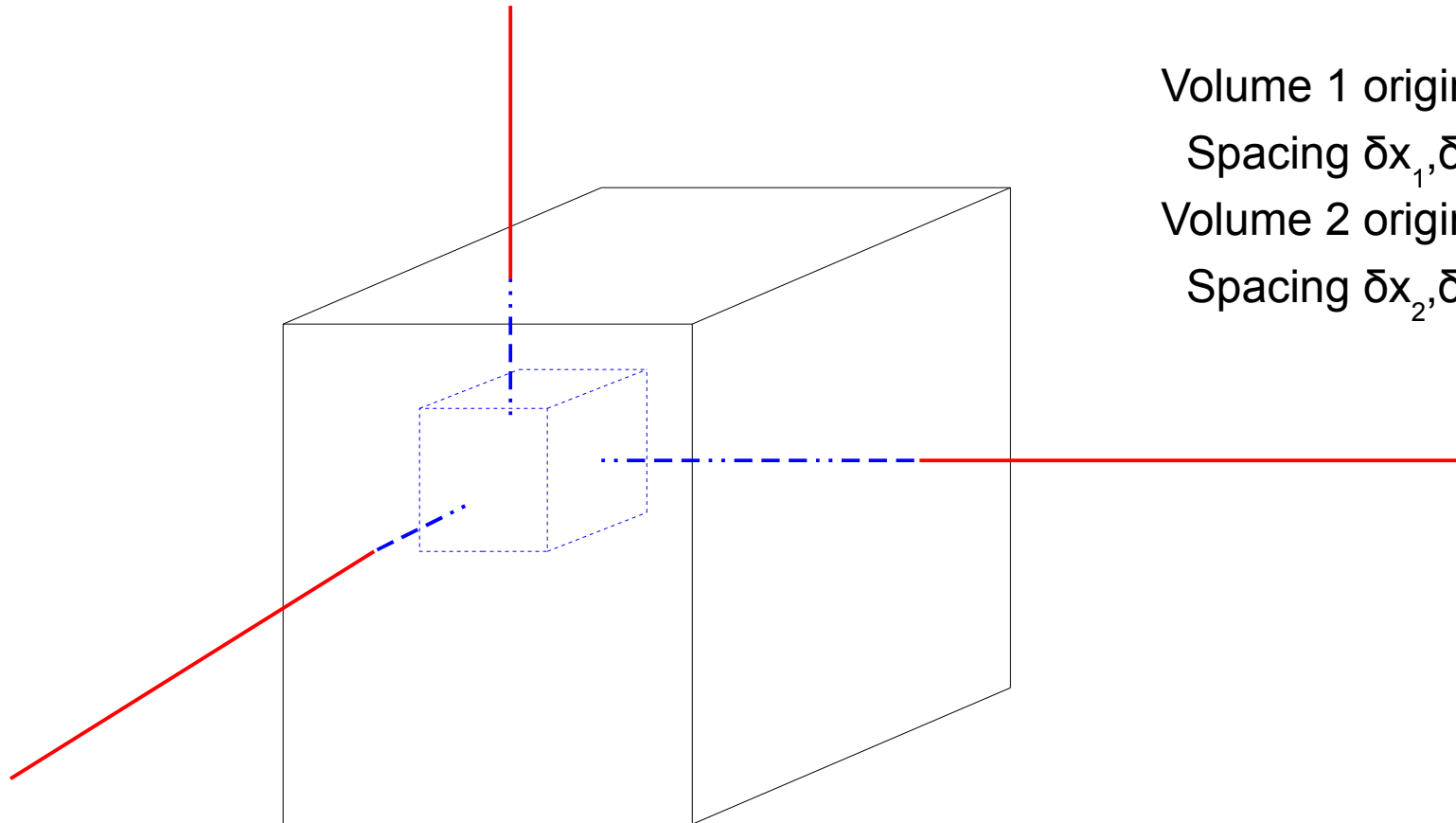
STEM **728 pixels/ micron**  
Image size 1.4x1.4 micron

# Complete data set in 2 pixels



# Data combinations

## Different origins and spacings



Volume 1 origin  $(x_1, y_1, z_1)$

Spacing  $\delta x_1, \delta y_1, \delta z_1,$

Volume 2 origin  $(x_2, y_2, z_2)$

Spacing  $\delta x_2, \delta y_2, \delta z_2,$

# Summary

- Multiple instruments to image the same sample
- different pixel resolutions is a challenge for data integration

