

BRUKER NANO ANALYTICS

# Overcome the Limitations of Conventional EDS with the new QUANTAX FlatQUAD

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# Today's Speakers

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**Andi Kaeppel**

Sr. Product Manager EDS/SEM



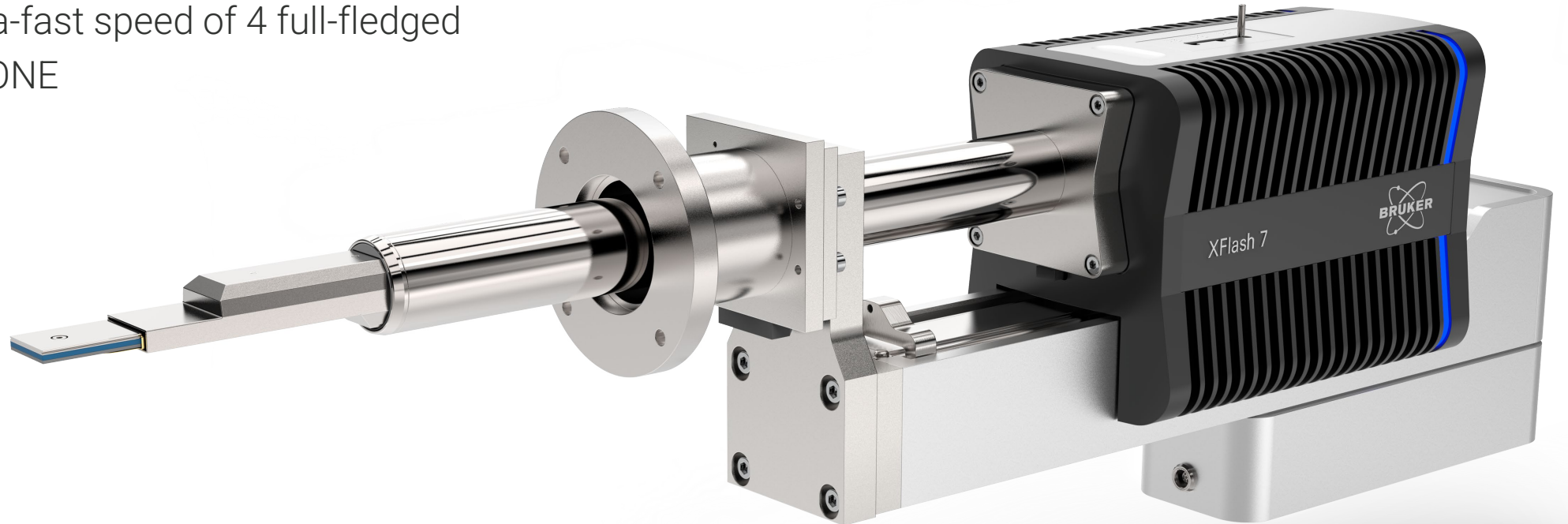
**Dr. Igor Nemeth**

Application Scientist EDS

# QUANTAX FlatQUAD – Overcome the limitations of conventional EDS

## Innovative annular 4-channel SDD design

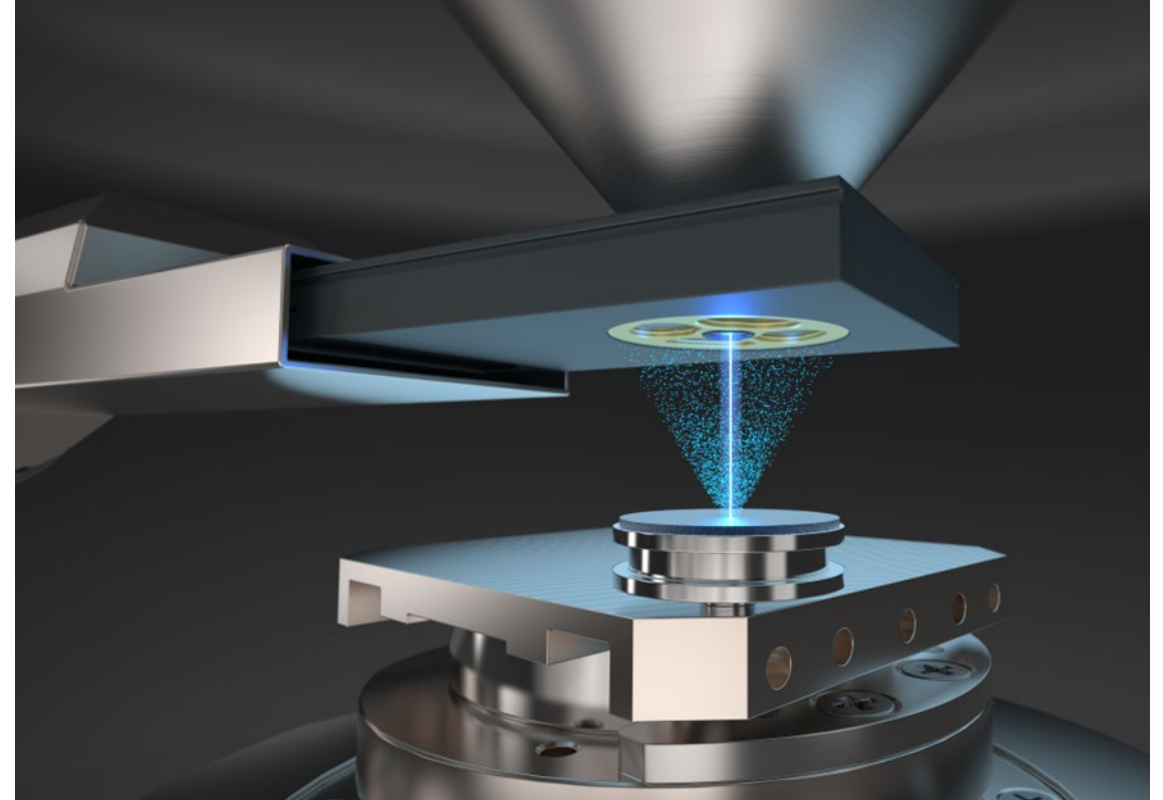
Benefit from high solid and take-off angles, as well as the ultra-fast speed of 4 full-fledged EDS detectors in ONE



XFlash® FlatQUAD - the detector for SEM and FIB-SEM

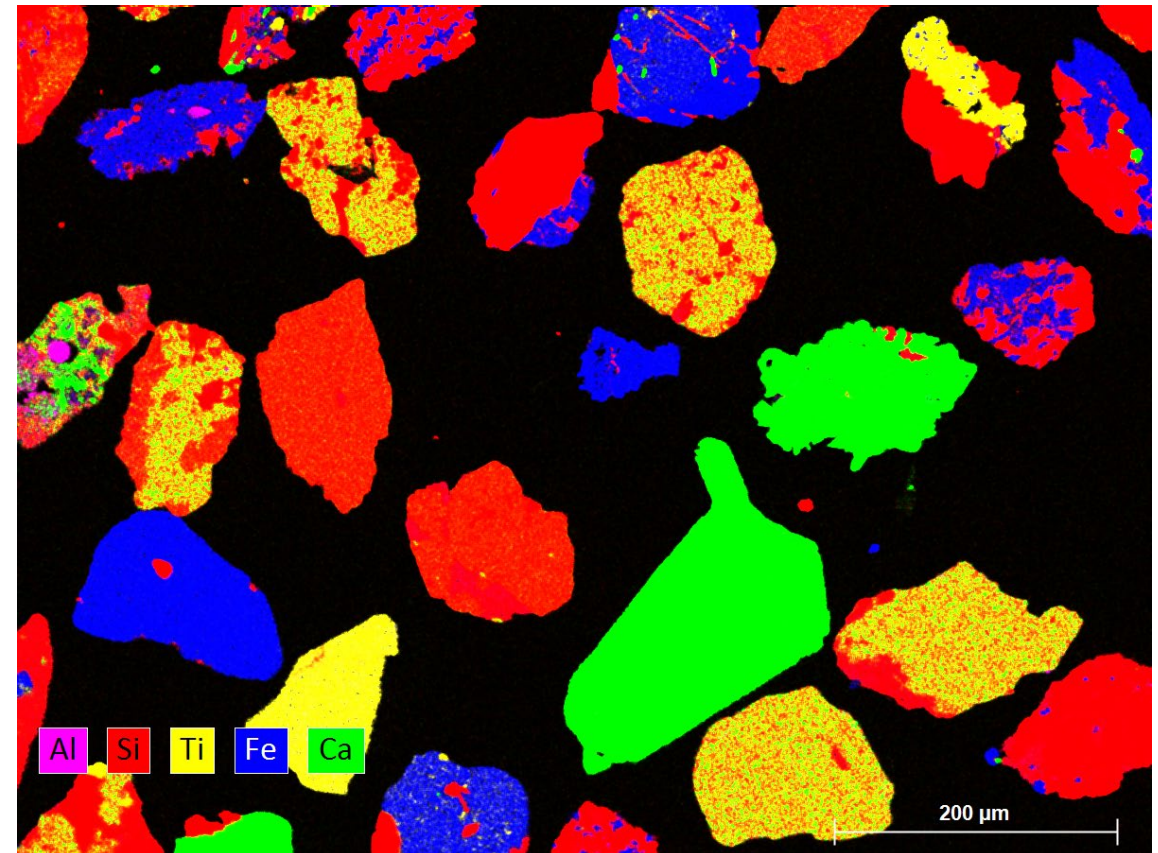
# QUANTAX FlatQUAD – Benefit: Ultra-Fast EDS Analysis at an Unmatched Throughput

- Take advantage of the market leading output count rate (OCR) of up to 3,200,000 cps without compromising analytical quality
- Maximize throughput even at low probe currents thanks to ultra-fast parallel signal processing
- Time critical investigations are no longer a challenge
- Measure more or more accurate in less time
- Detection of features based on real, quantitative chemical data on heterogeneous samples with no difference in mean atomic number
- Uncompromised data integrity with real-time spectral imaging and ESPRIT LiveMap



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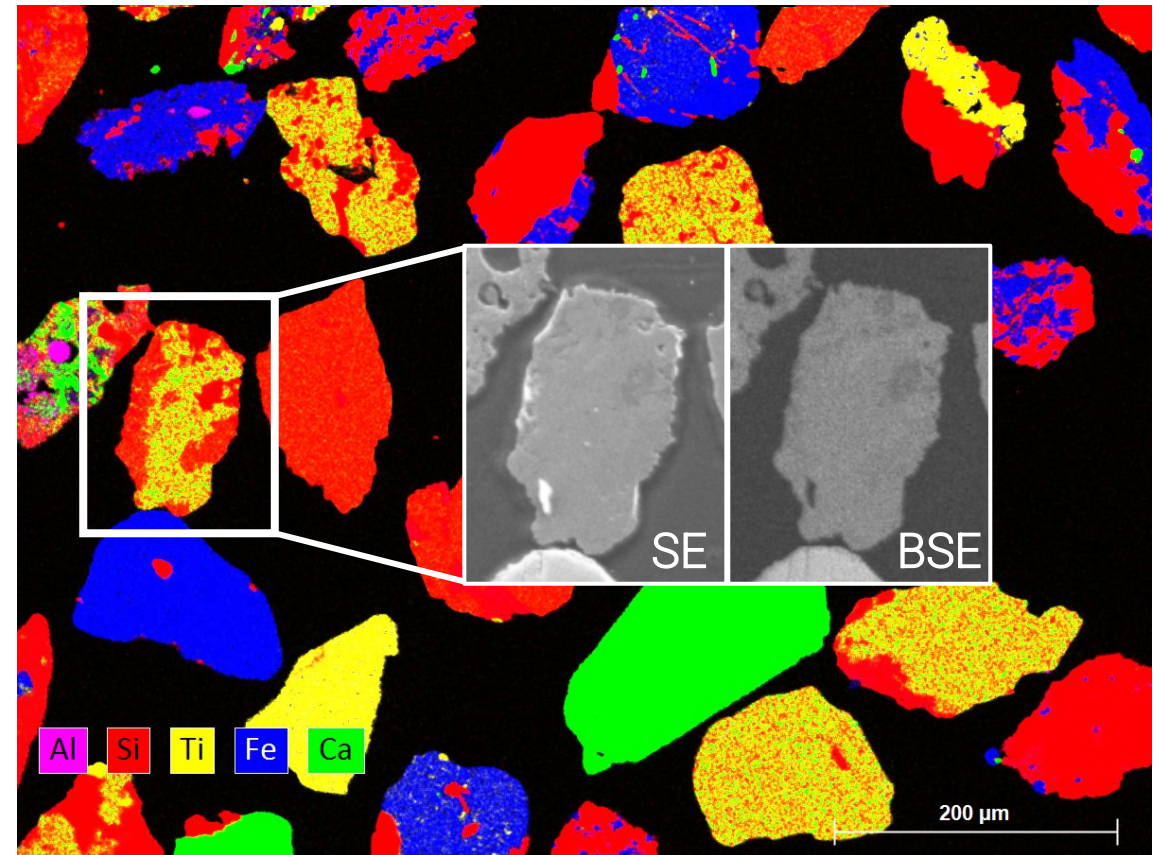
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Chemical snapshot (single frame EDS map) of embedded particles acquired in a few seconds at 15 kV and 3 nA probe current with an OCR of 1,169,000 cps.

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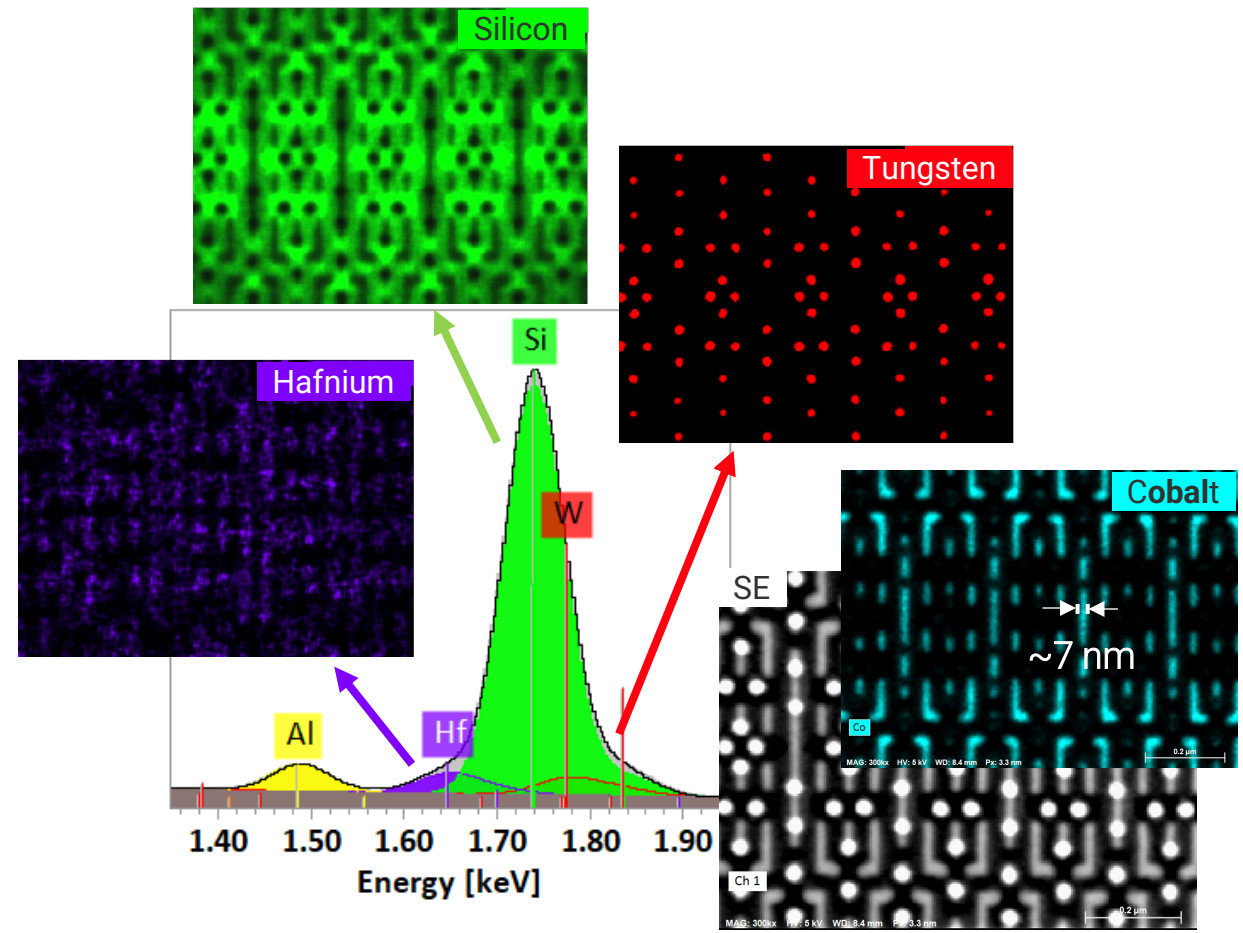
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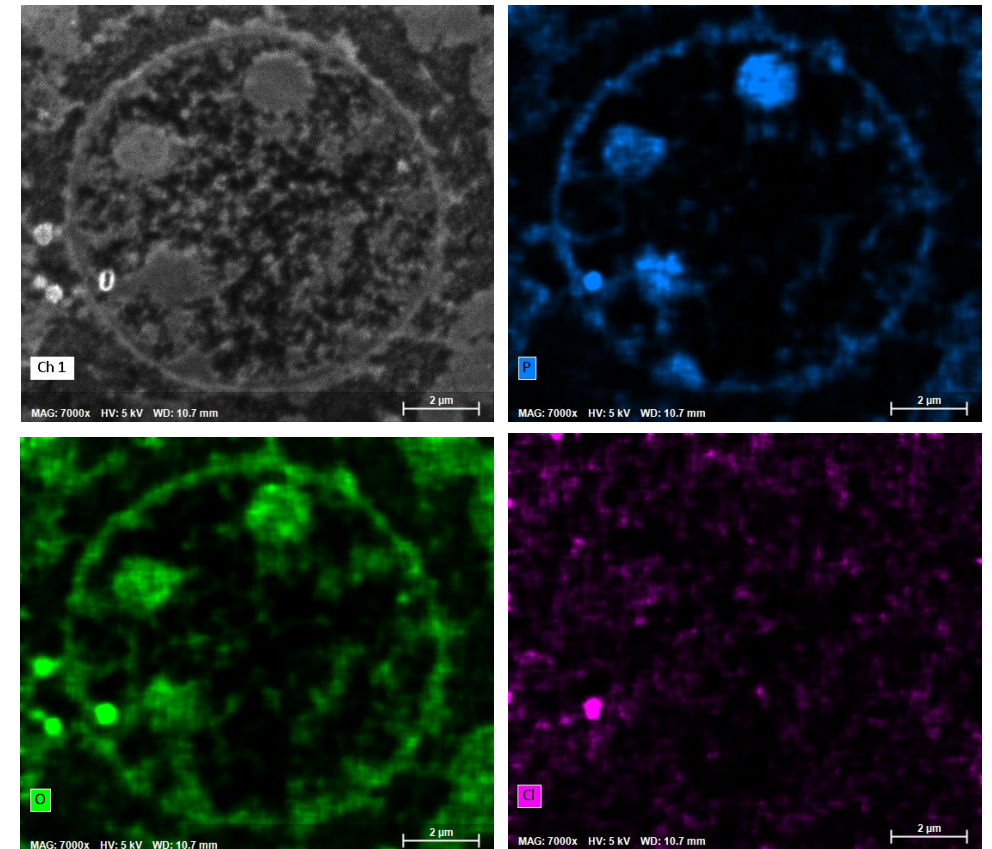
# QUANTAX FlatQUAD – Benefit: One analytical detector for every task

- All in one detector for every task from fast acquisition to accurate quantification
- Ideal EDS detector for challenging samples
  - Ultra-fast, real-time imaging
  - Accurate spectroscopy and reliable results
- Detection range from very light to heavy elements
- No limitation of analytical conditions
- No additional inclined EDS detector required



# QUANTAX FlatQUAD – Benefit: Elemental Mapping of Beam Sensitive Samples

- Make the elemental mapping of delicate samples, such as biological samples and semiconductors viable supported by the unique design of the XFlash® FlatQUAD detector
- Minimum electron beam dose to analyze samples due to the high collection efficiency of the XFlash® FlatQUAD detector
- Prevent sample damage during imaging, without the loss in image quality seen using a conventional EDS detector.
- Minimal need for sample preparation, with often no sample preparation at all.



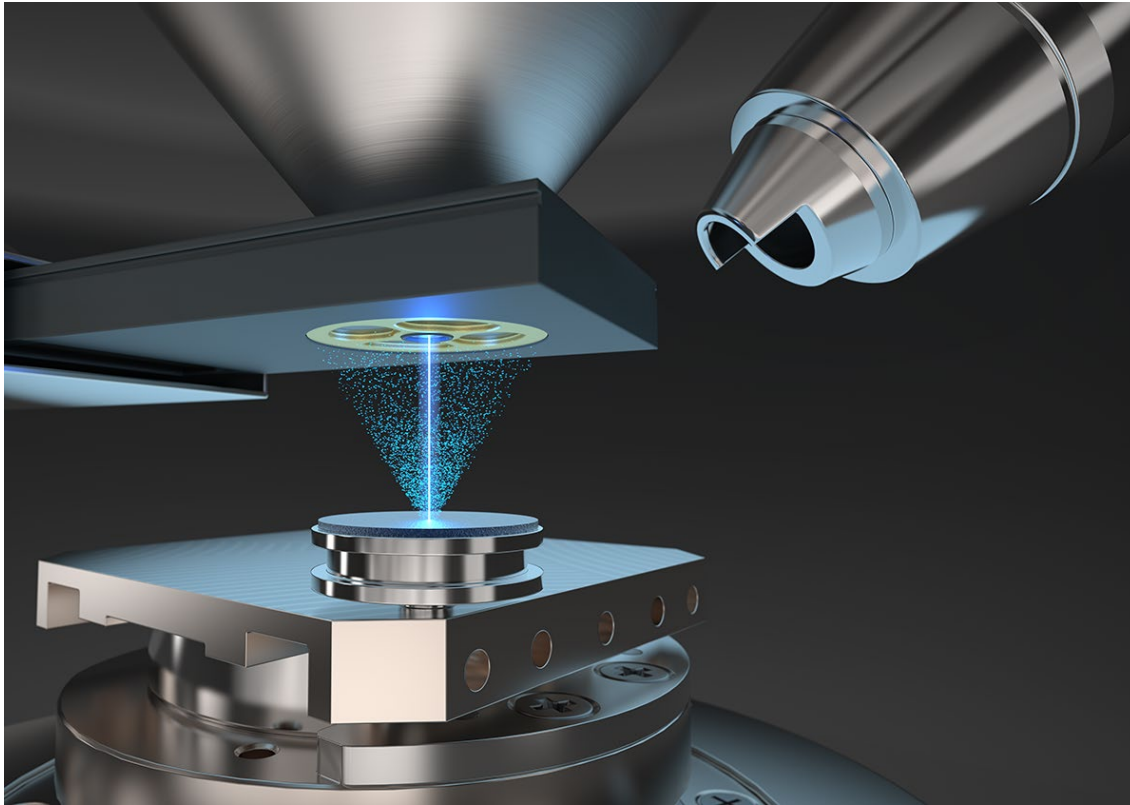
Elemental maps of 100 nm thin resin cross section of cancer cells acquired at 5 kV, 580 pA, and output count rate (OCR) of 109,800 cps. Sample courtesy: Univ. Bordeaux



## QUANTAX FlatQUAD – Features

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### QUANTAX FlatQUAD vs. conventional inclined EDS detector



- More than 25 x higher collection solid angle
- 4 x higher maximum processing speed
- 2 x higher take-off angle
- Same spectral performance

## Application examples

### Battery cathode particles

Electron microscopy: SE imaging gives morphological information:

- High sample topography

Raw material: analysis “as received”:

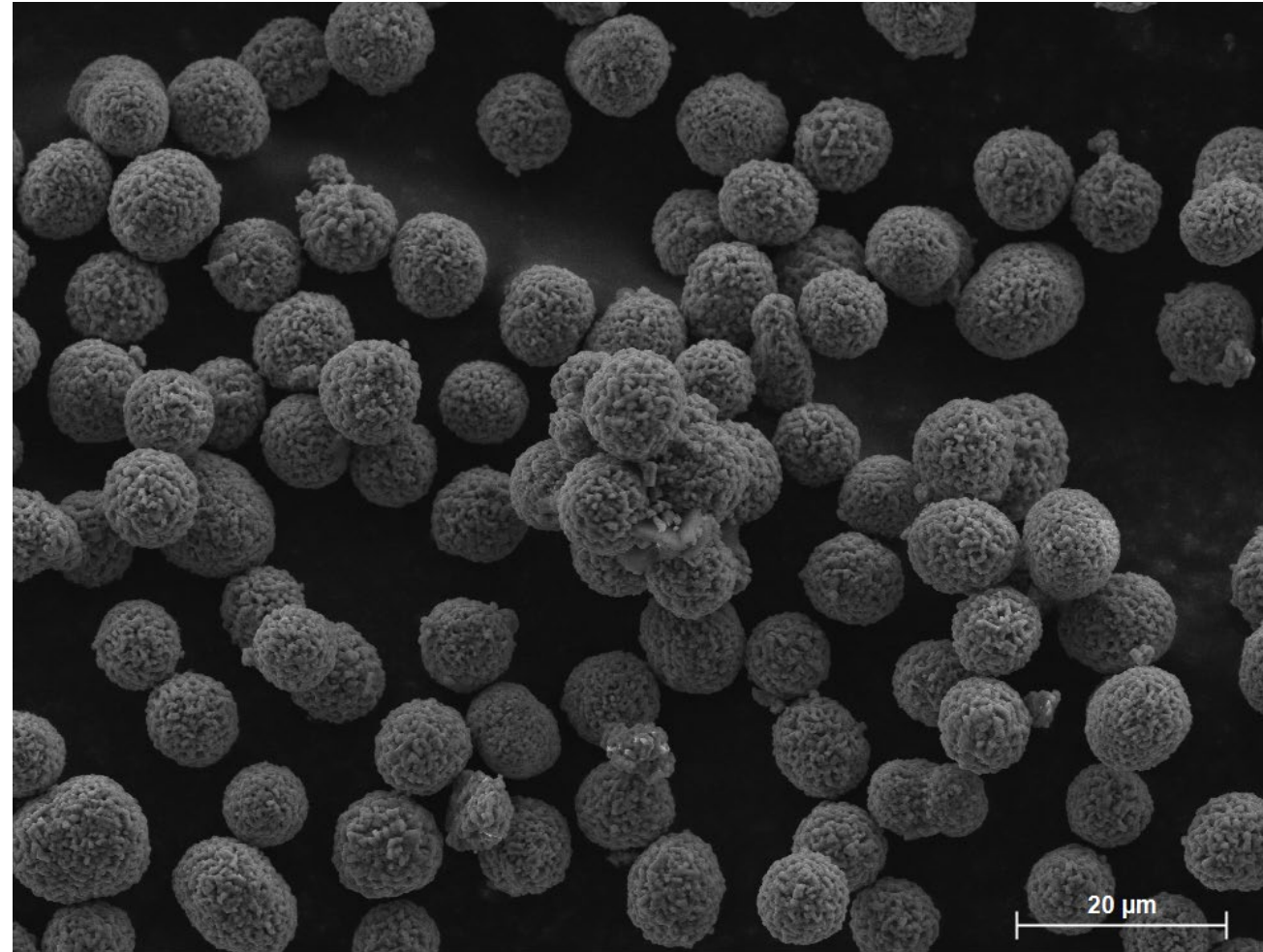
- No sample preparation

Particles loosely distributed on sticky carbon pad

- No low vacuum, no inert gas transfer and no sample coating

Material is conductive, but loose:

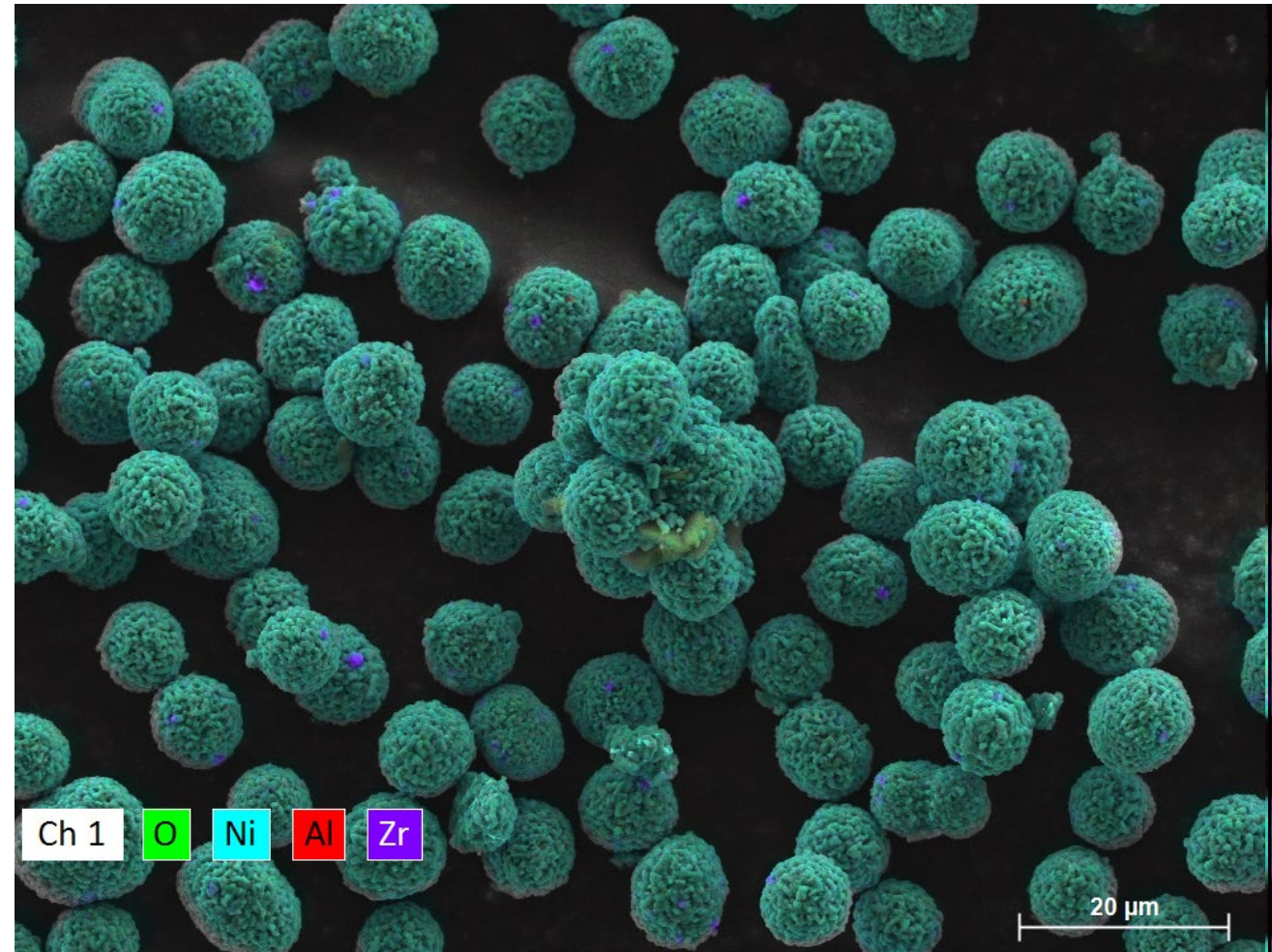
- Beam sensitive



SE image of NCM particles on carbon pad

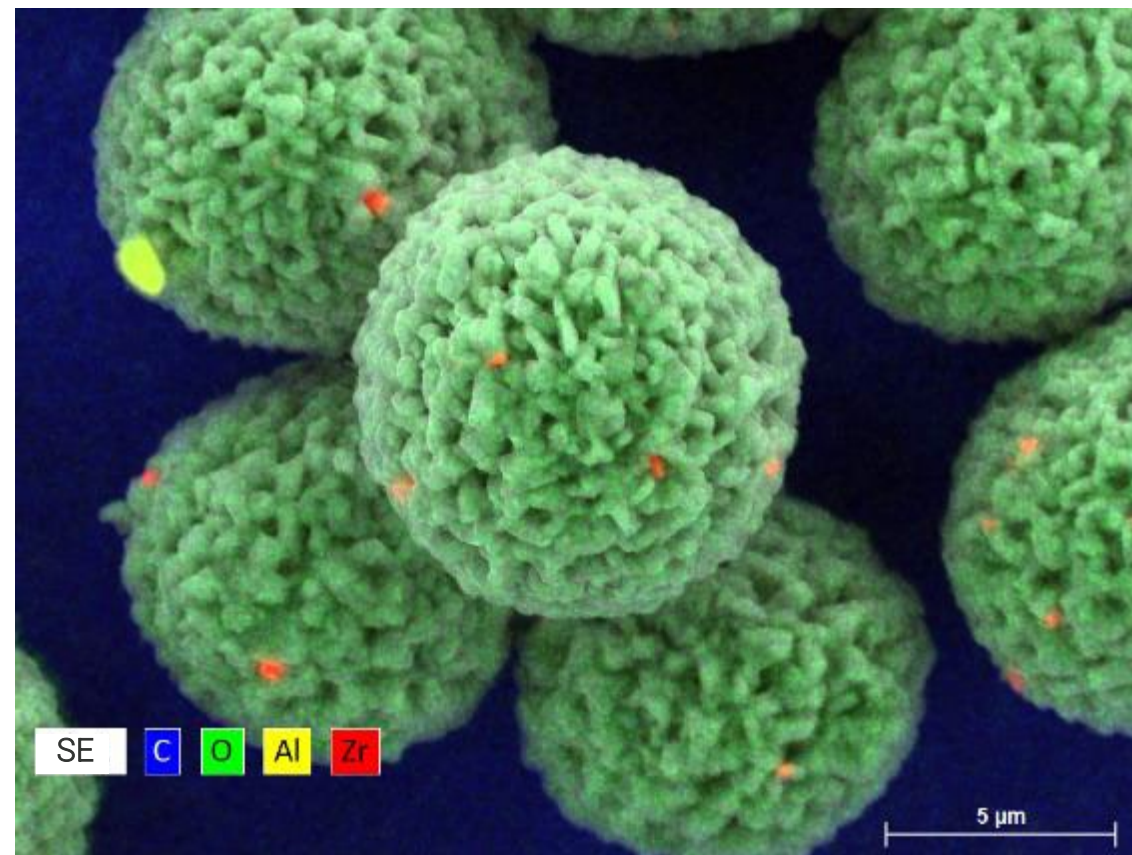
## Application example: Battery cathode particles

- Flatquad vs. conventional EDS detector:
  - Faster mapping
  - No shadowingMore information
- Choice of optimal acceleration voltage  
spatial resolution vs. sufficient excitation of  
element lines
- Proof of spectrum quality:  
overlapping element peaks
- High sensitivity allows detection of  
contaminants in short time.



FlatQUAD 12kV Map with SE image overlay, 10 minutes

# Comparison of conventional detector and FlatQUAD: NCM particles



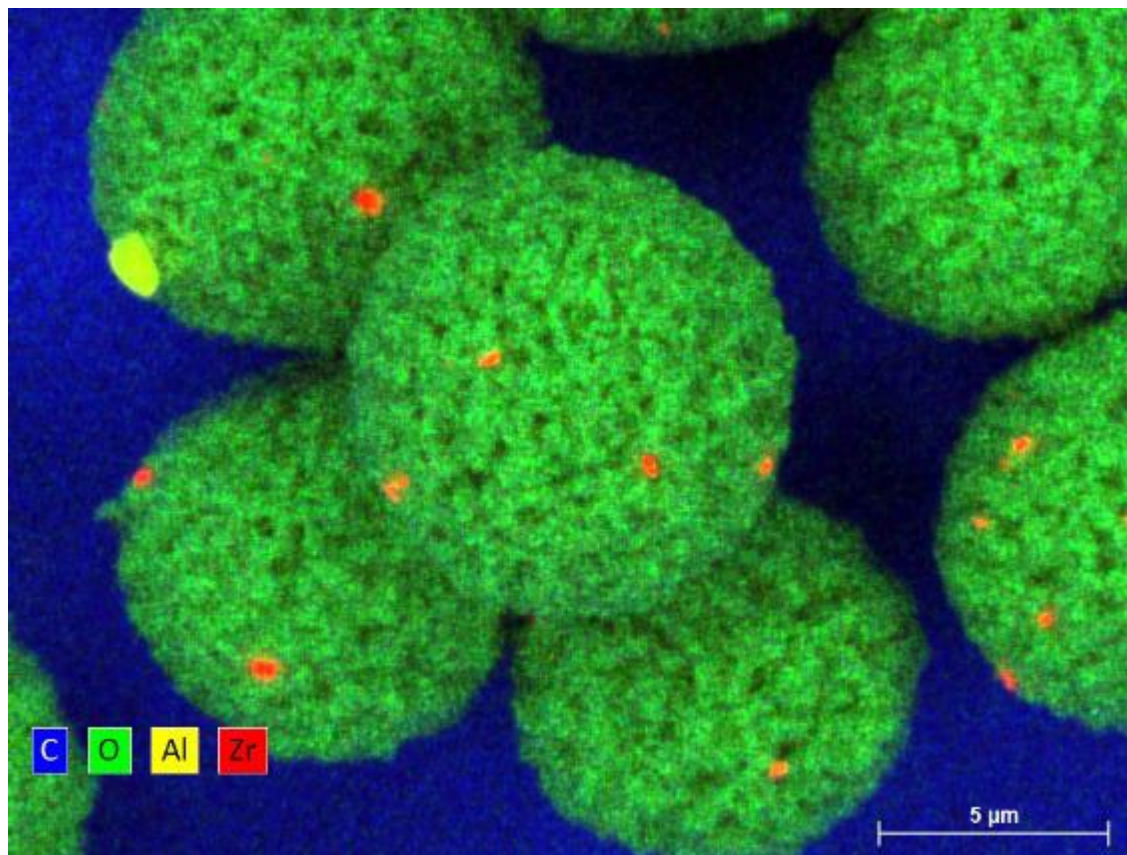
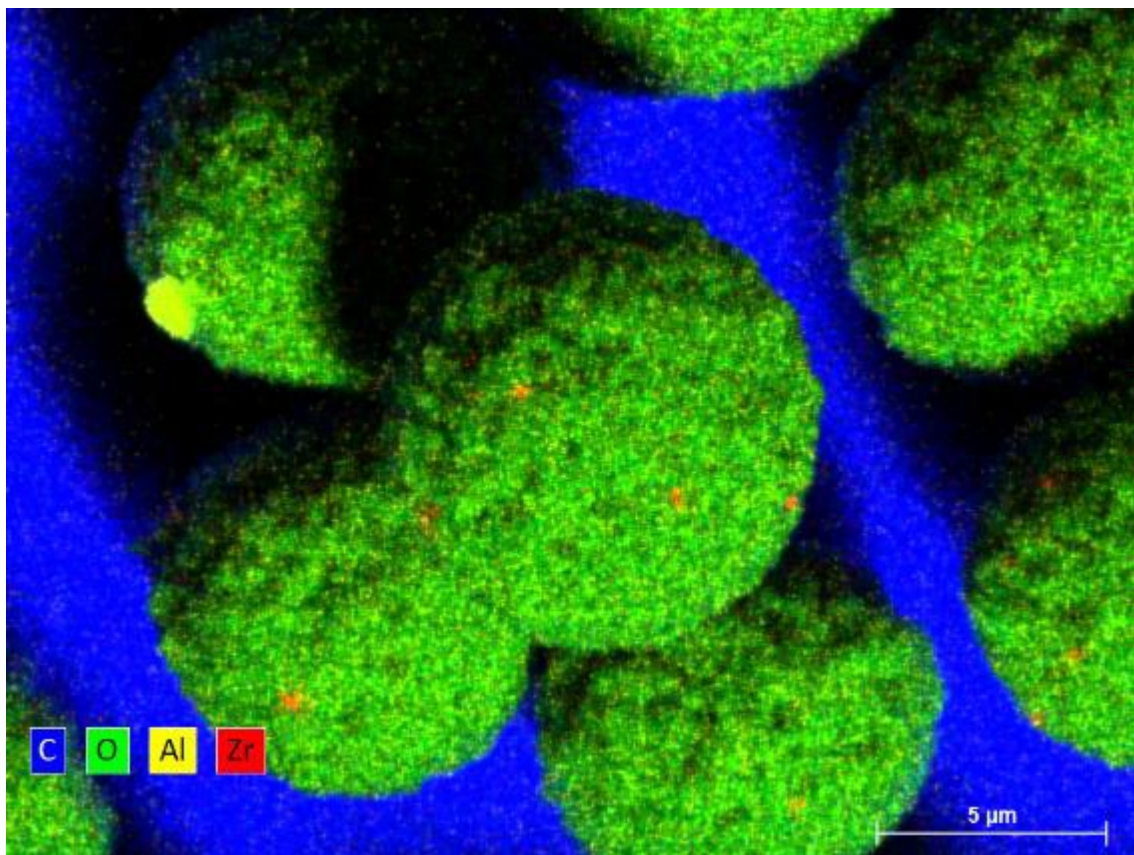
Conventional EDS 60mm<sup>2</sup>

12 kV / 510pA / 600s

XFlash® FlatQUAD



# Comparison of conventional detector and FlatQUAD: NCM particles



Conventional EDS 60mm<sup>2</sup>

7190 cps

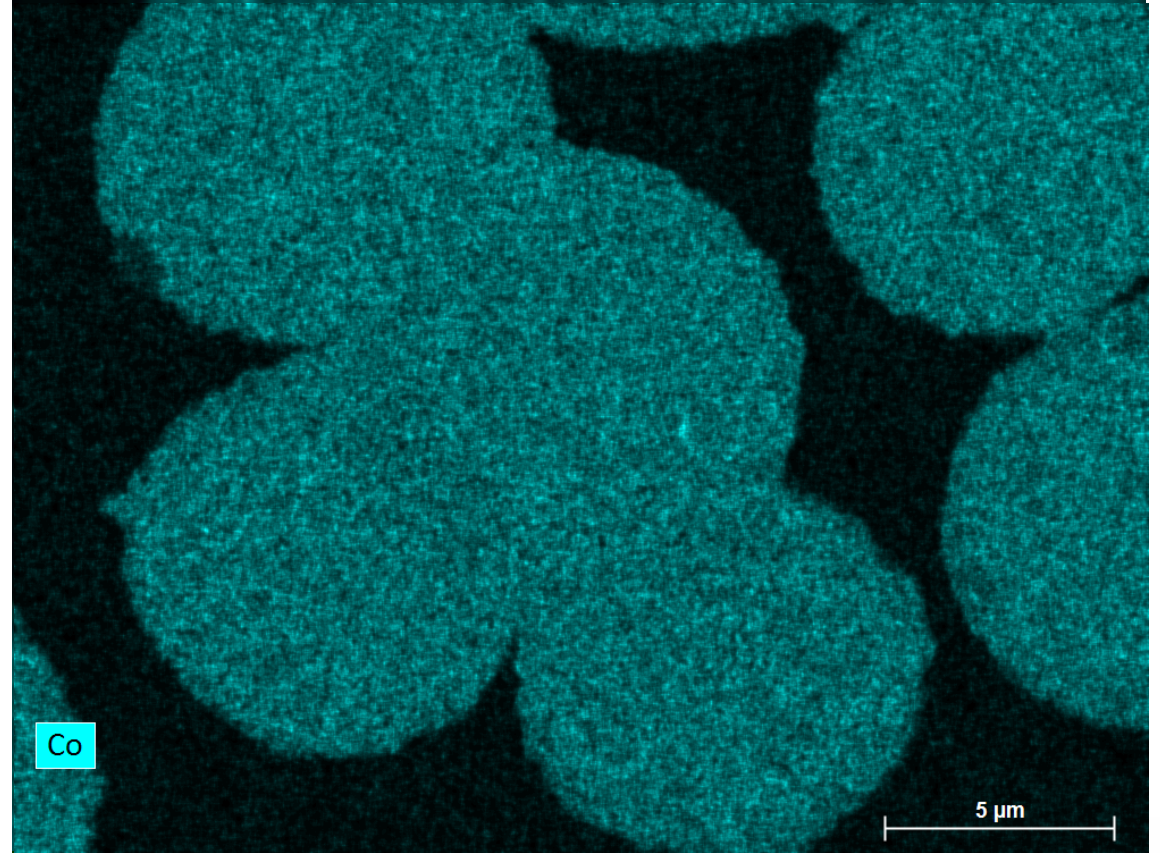
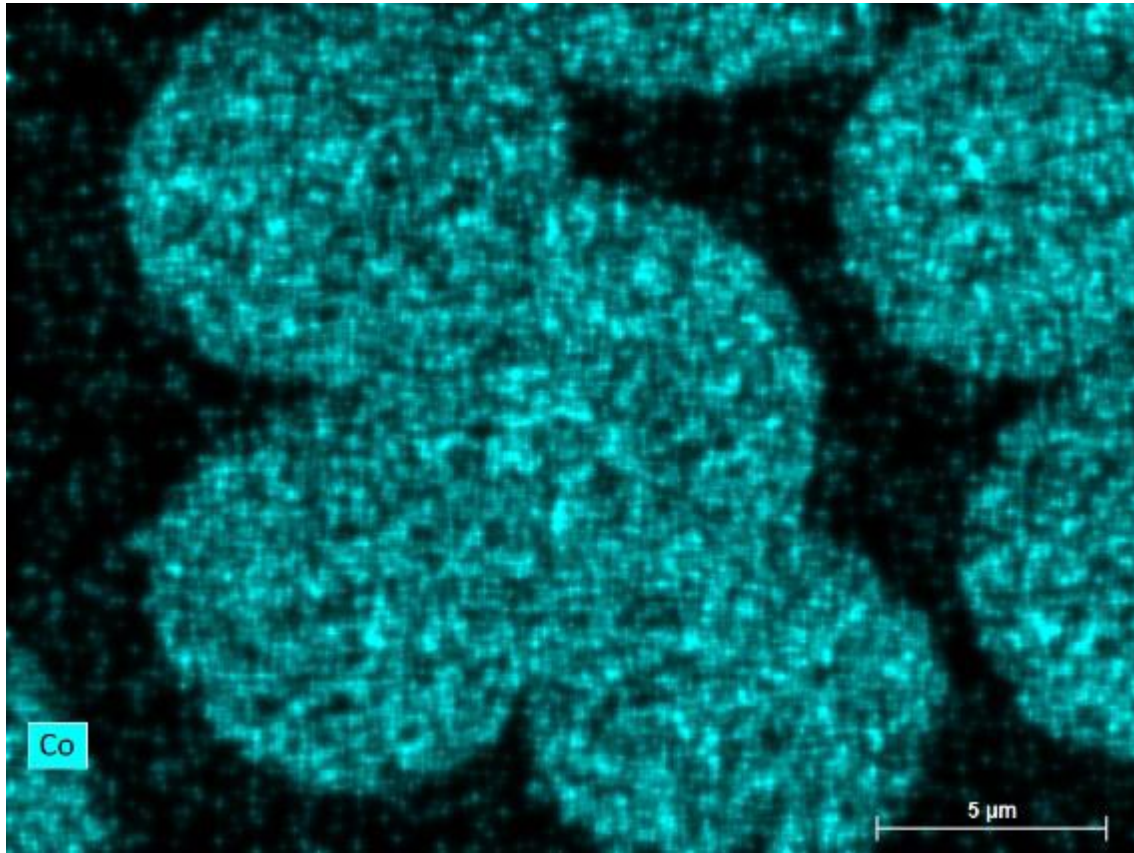
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XFlash® FlatQUAD

133,900 cps



# Comparison of conventional detector and FlatQUAD: NCM particles



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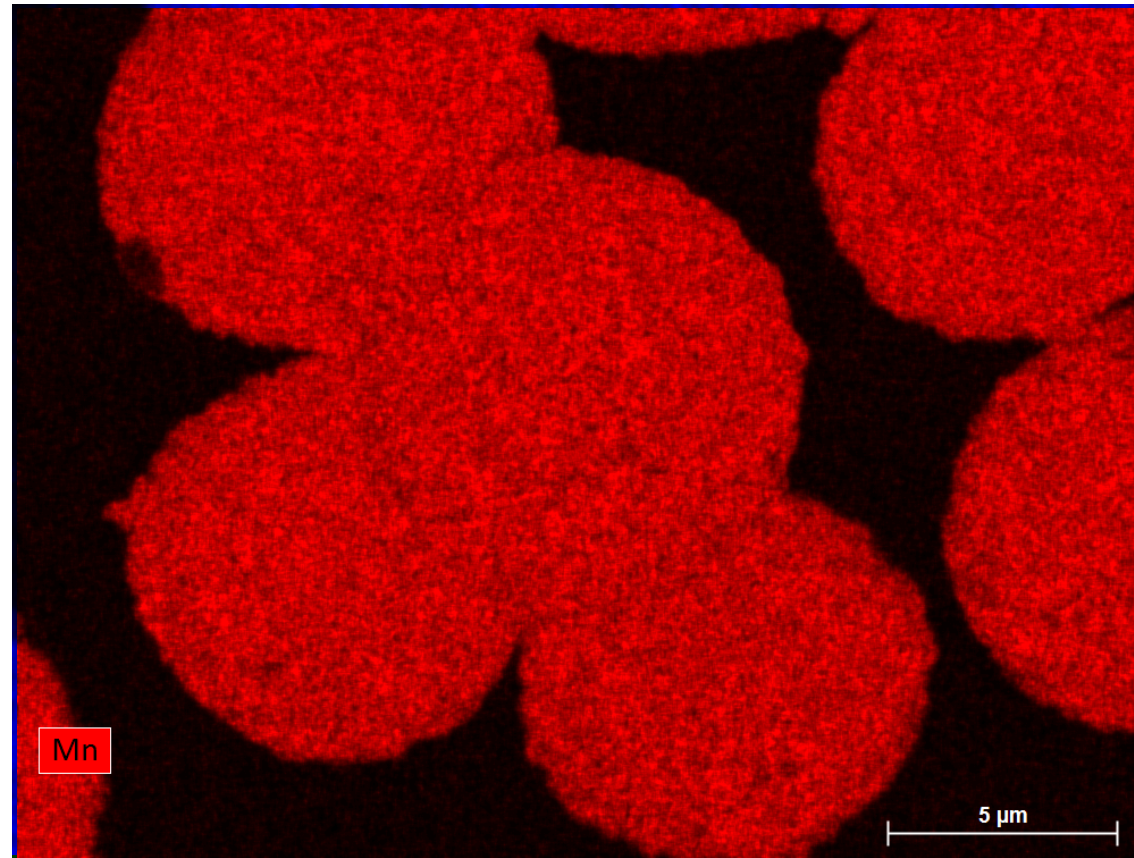
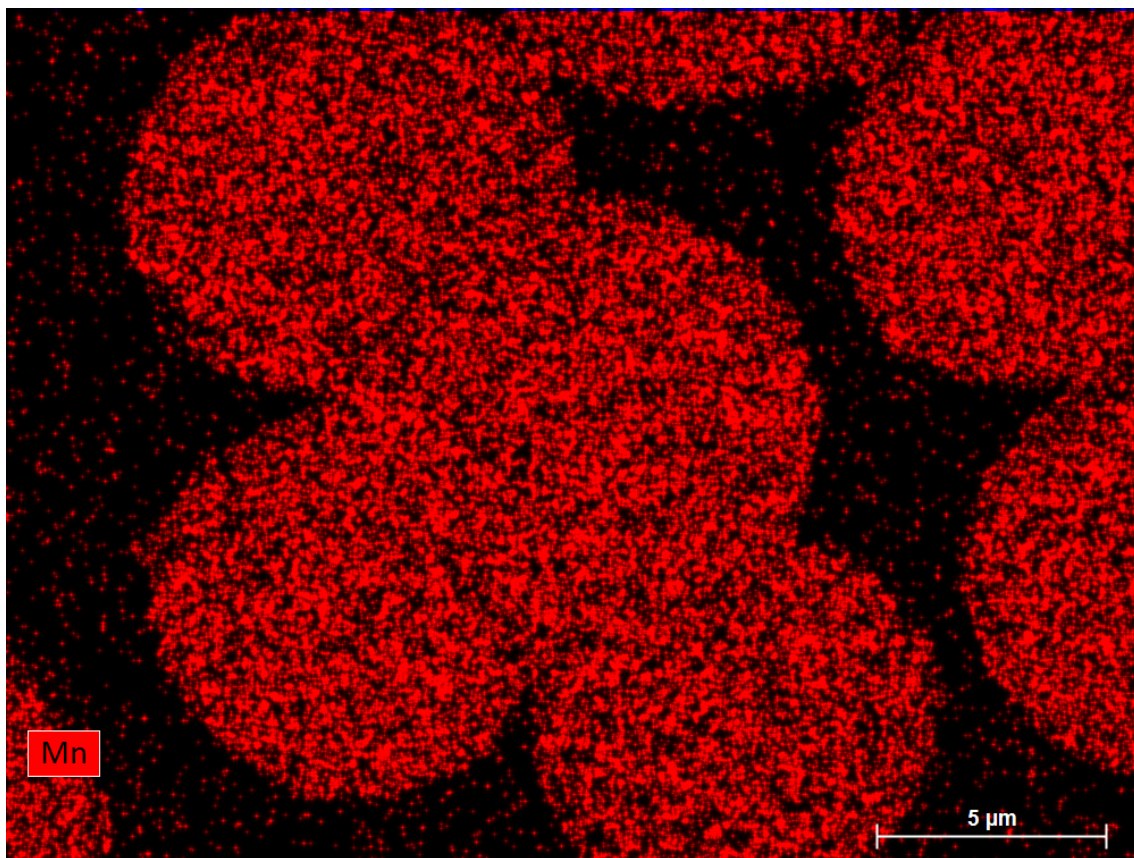
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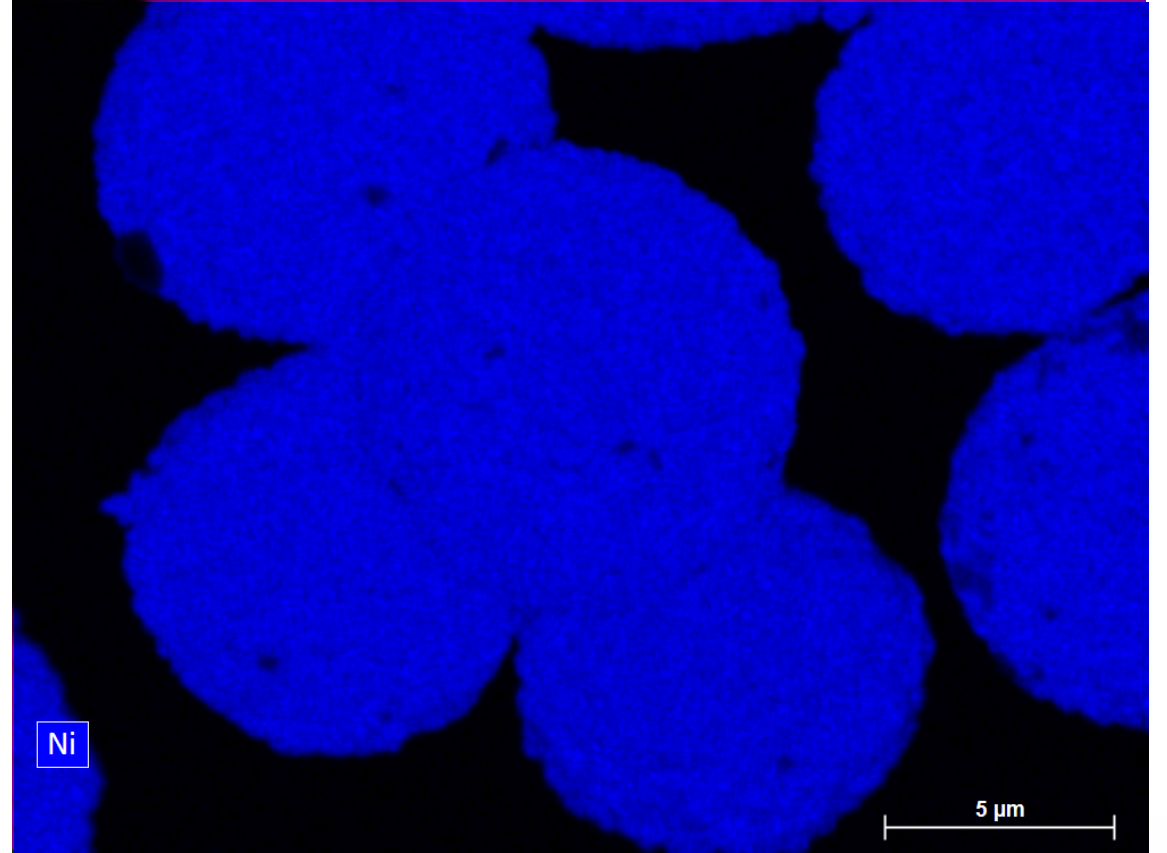
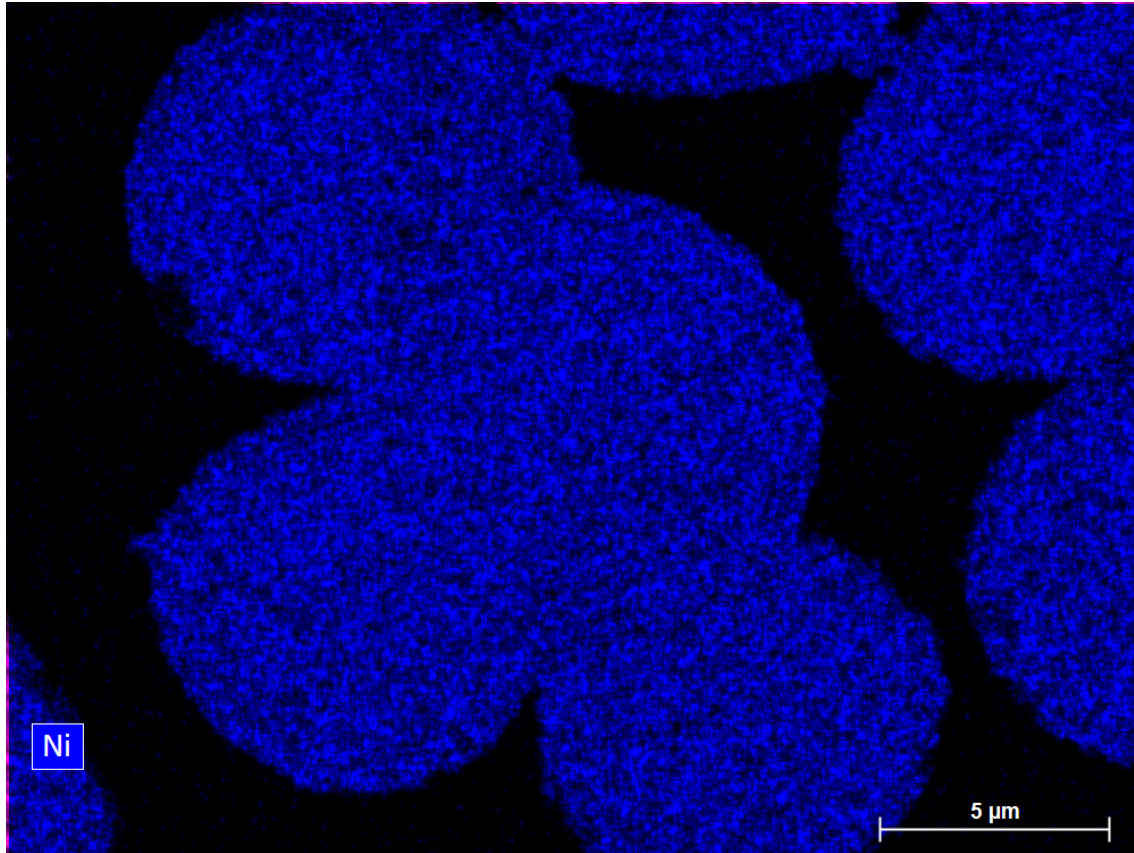
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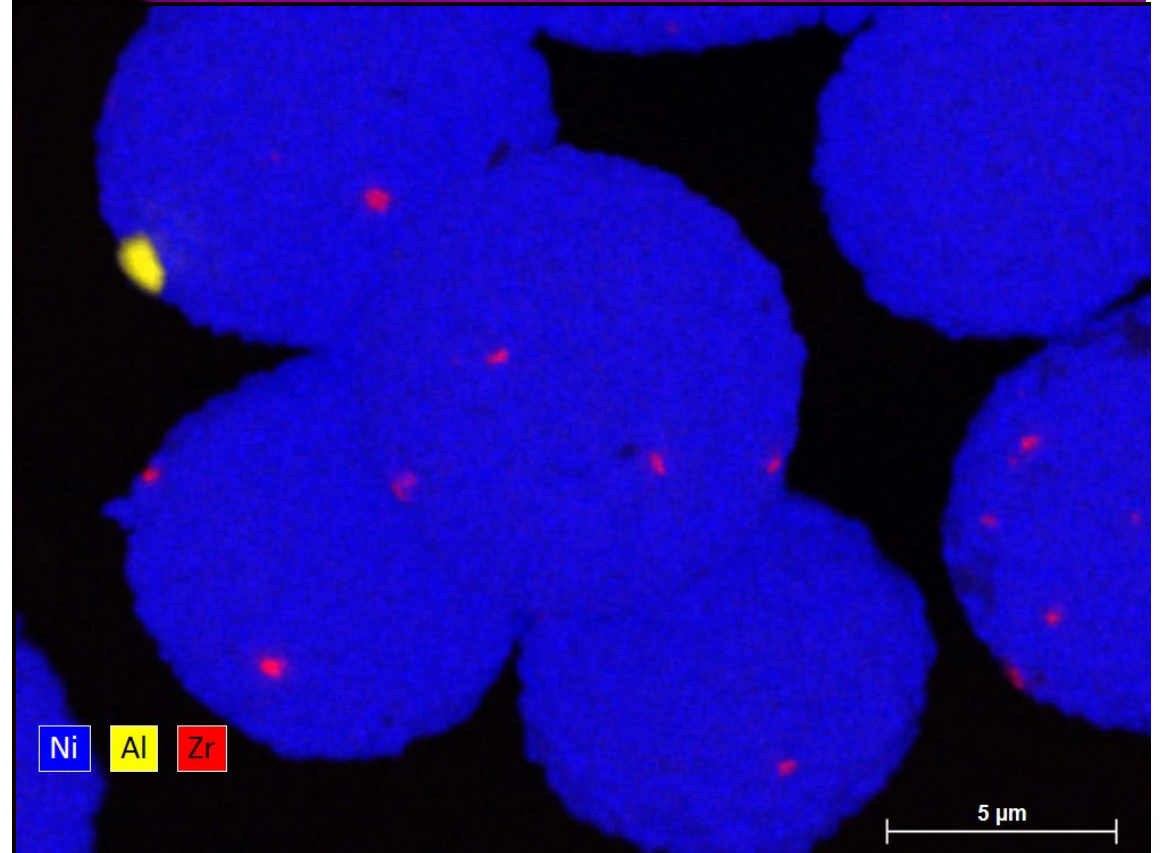
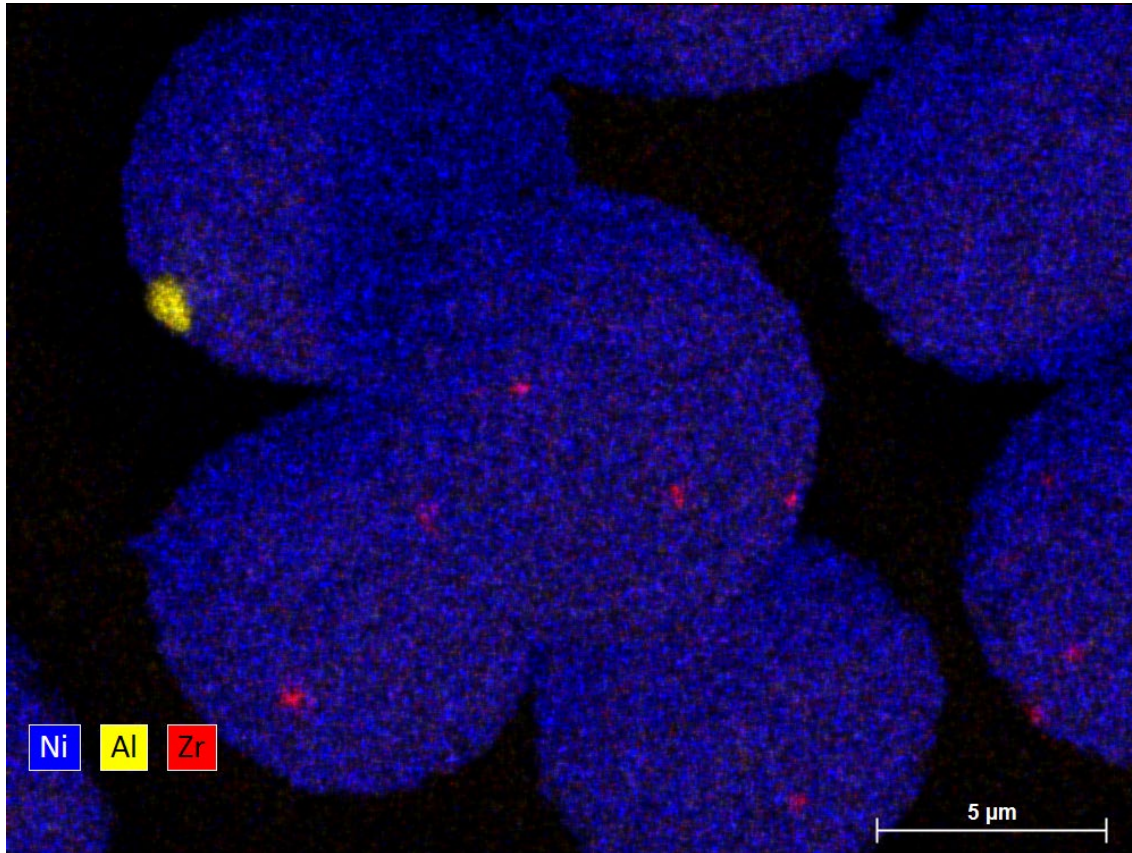
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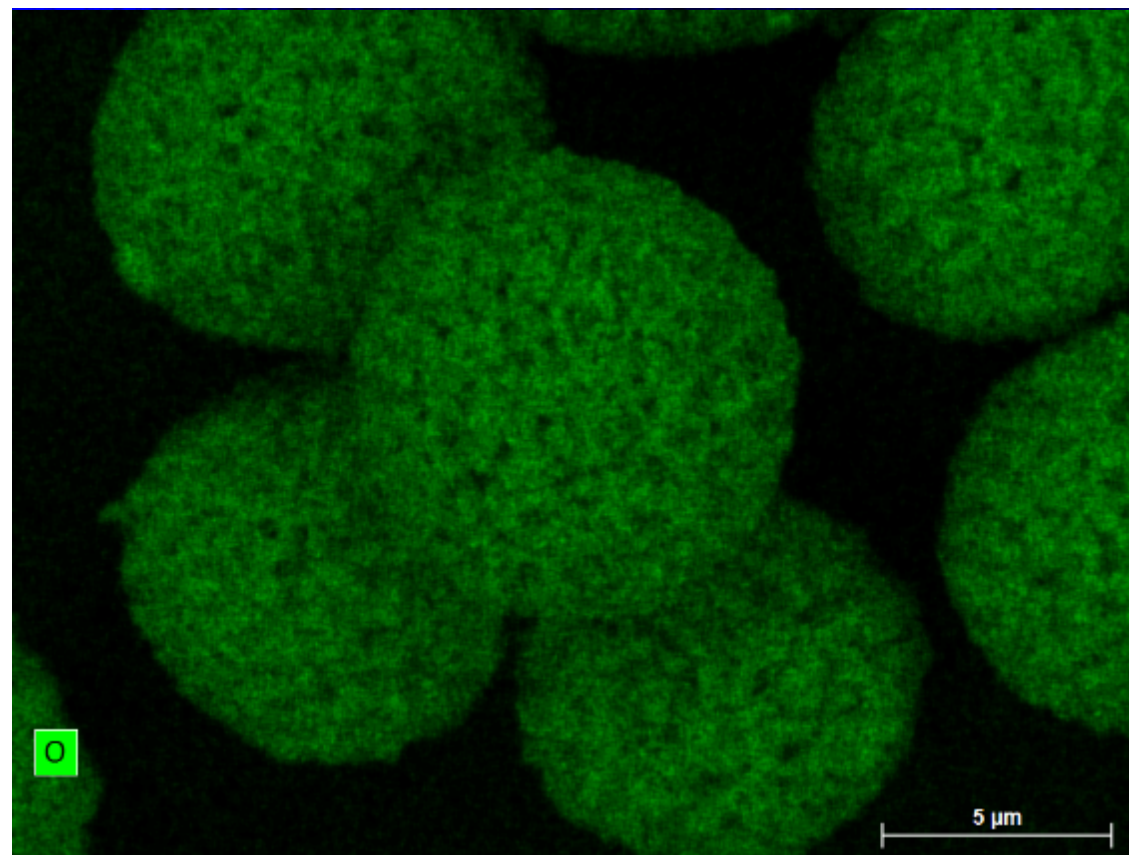
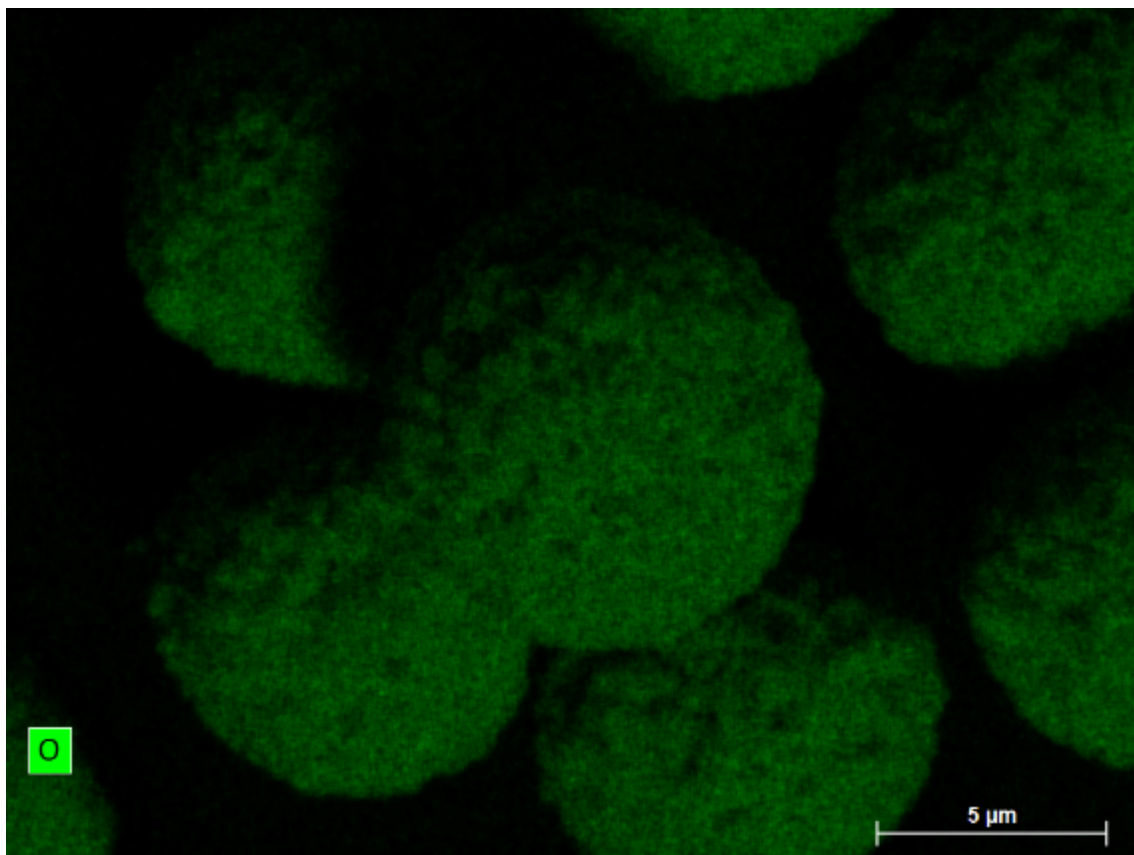
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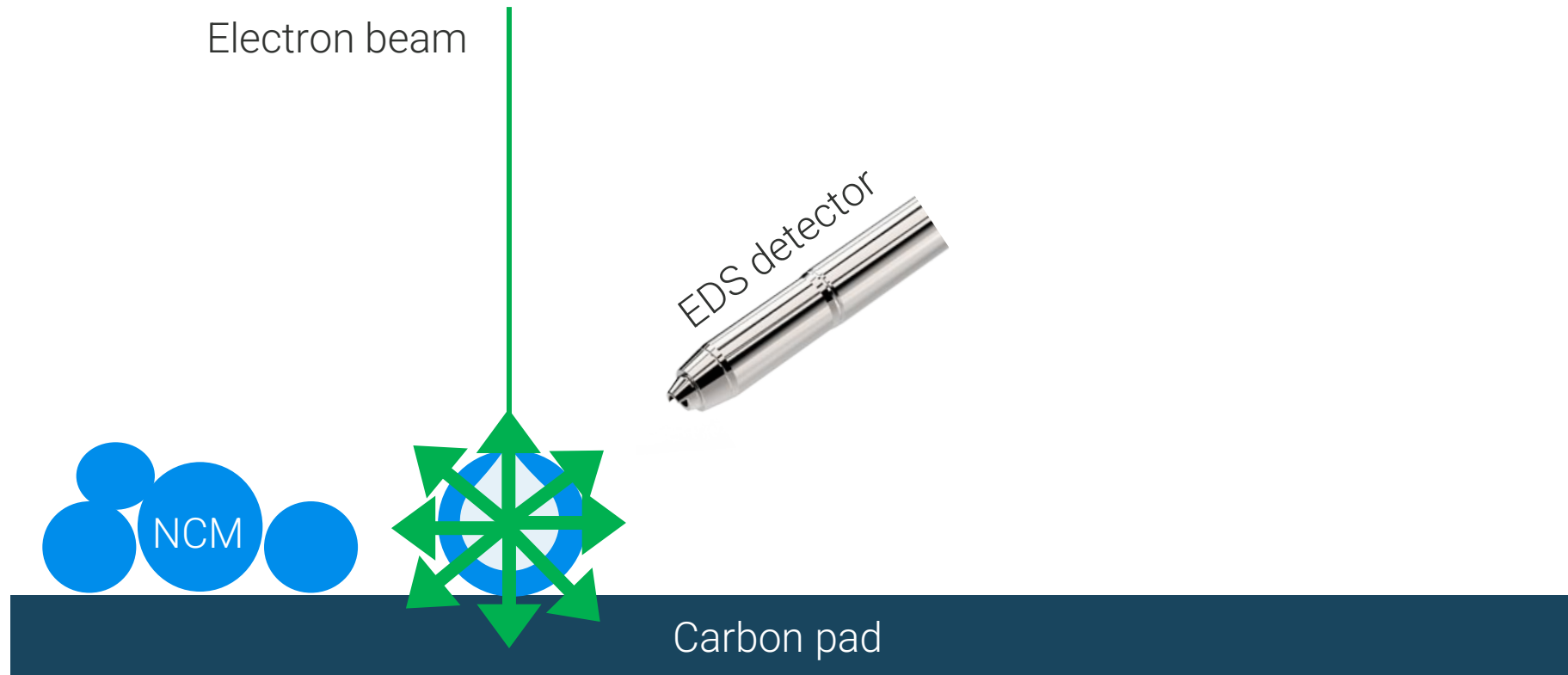
12 kV / 510pA / 600s

XFlash® FlatQUAD

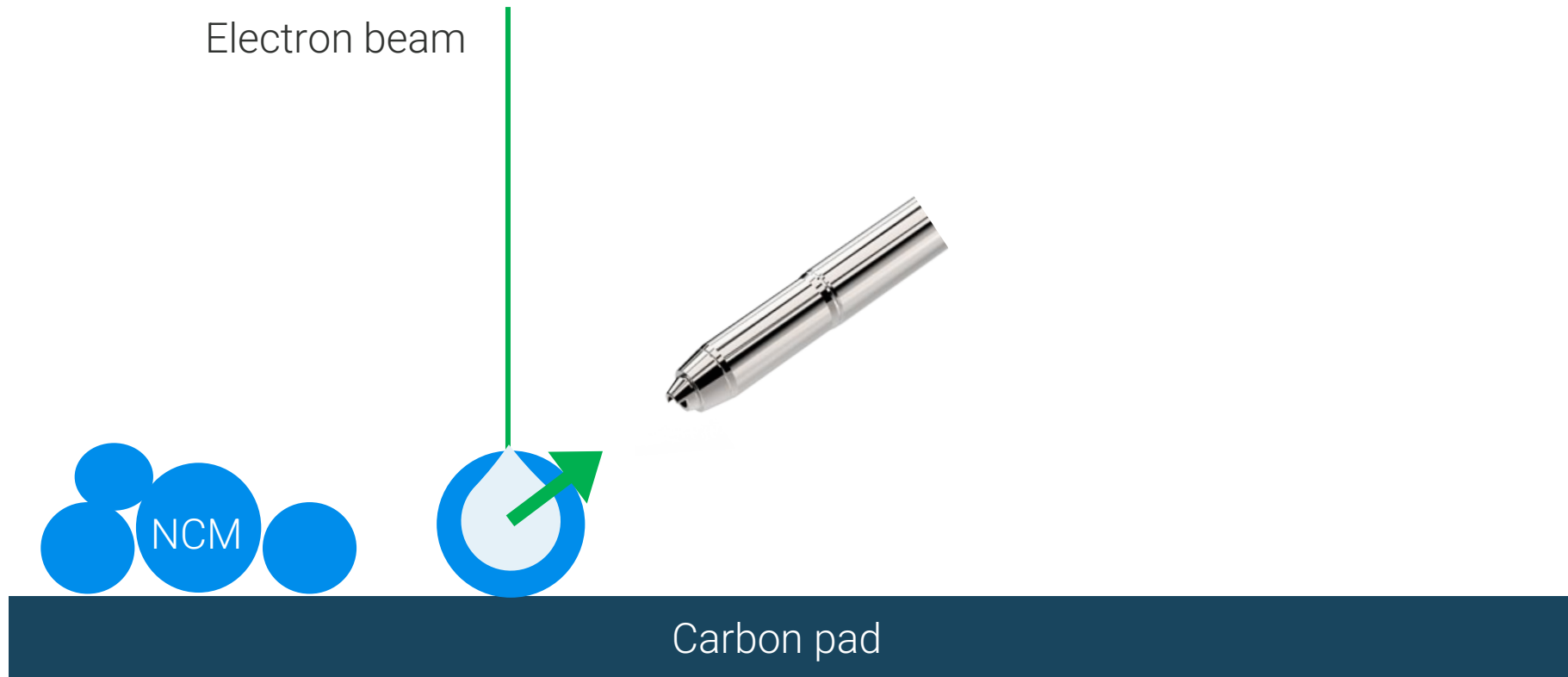
133,900 cps



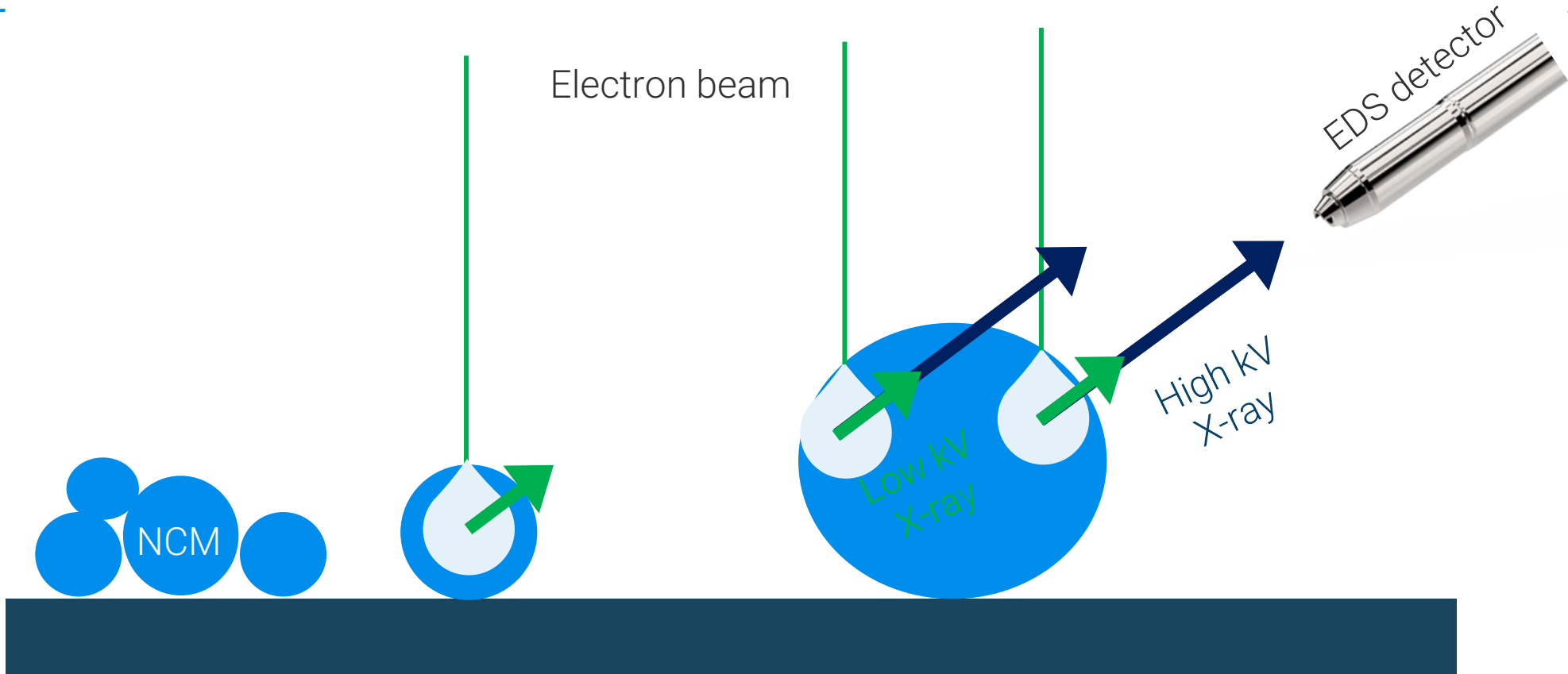
# Sample probing: X-ray interaction volume in high-topography samples



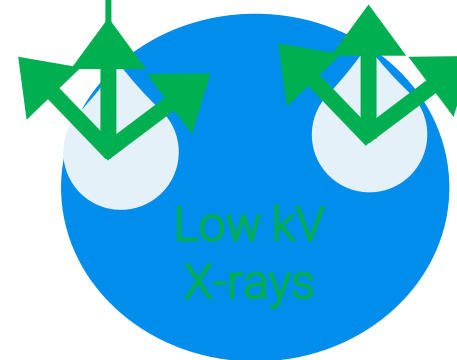
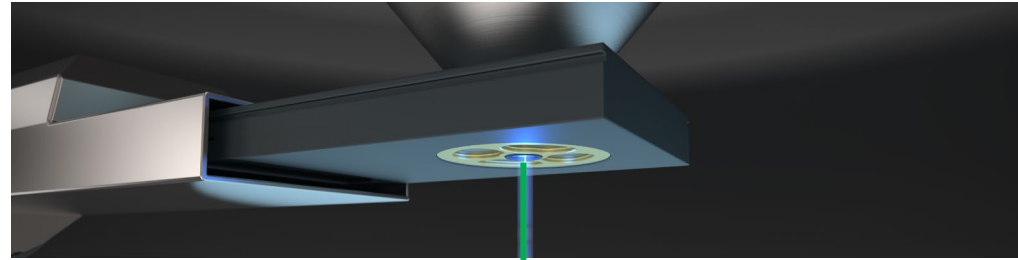
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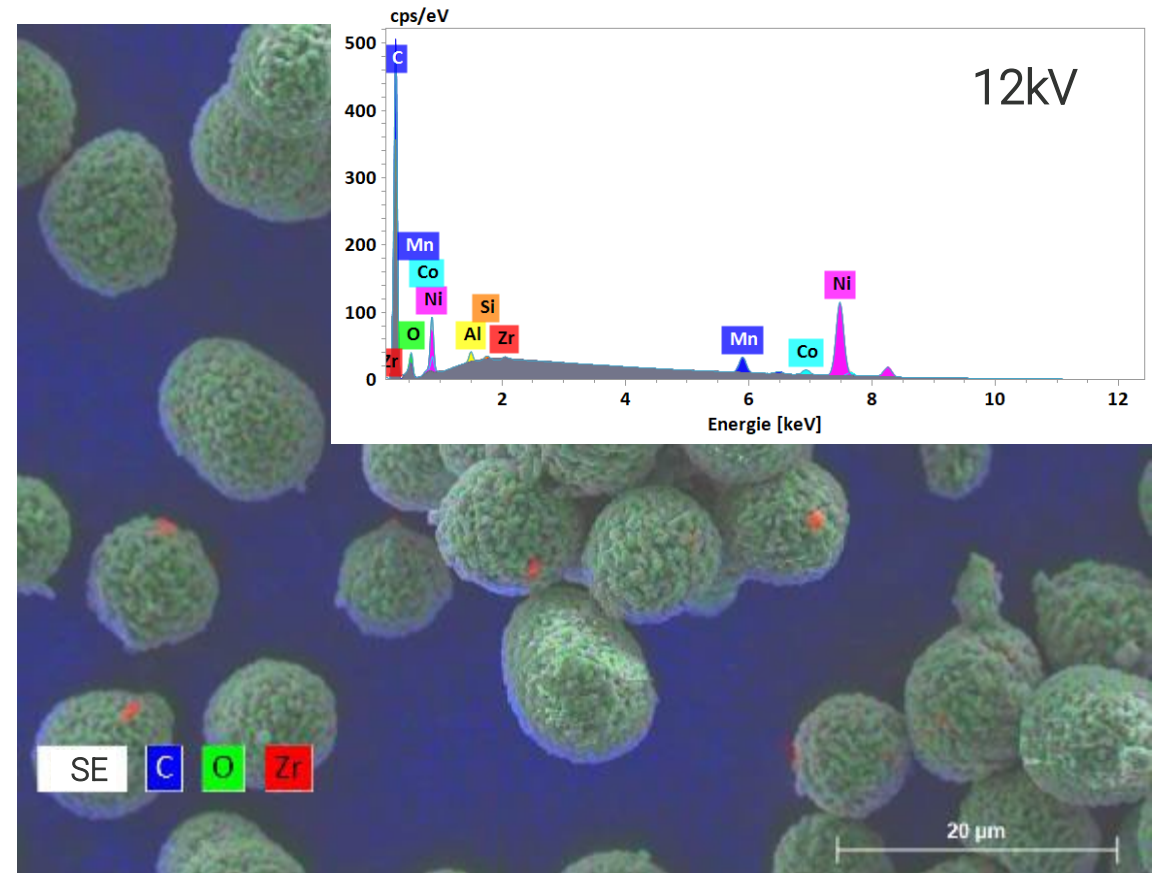
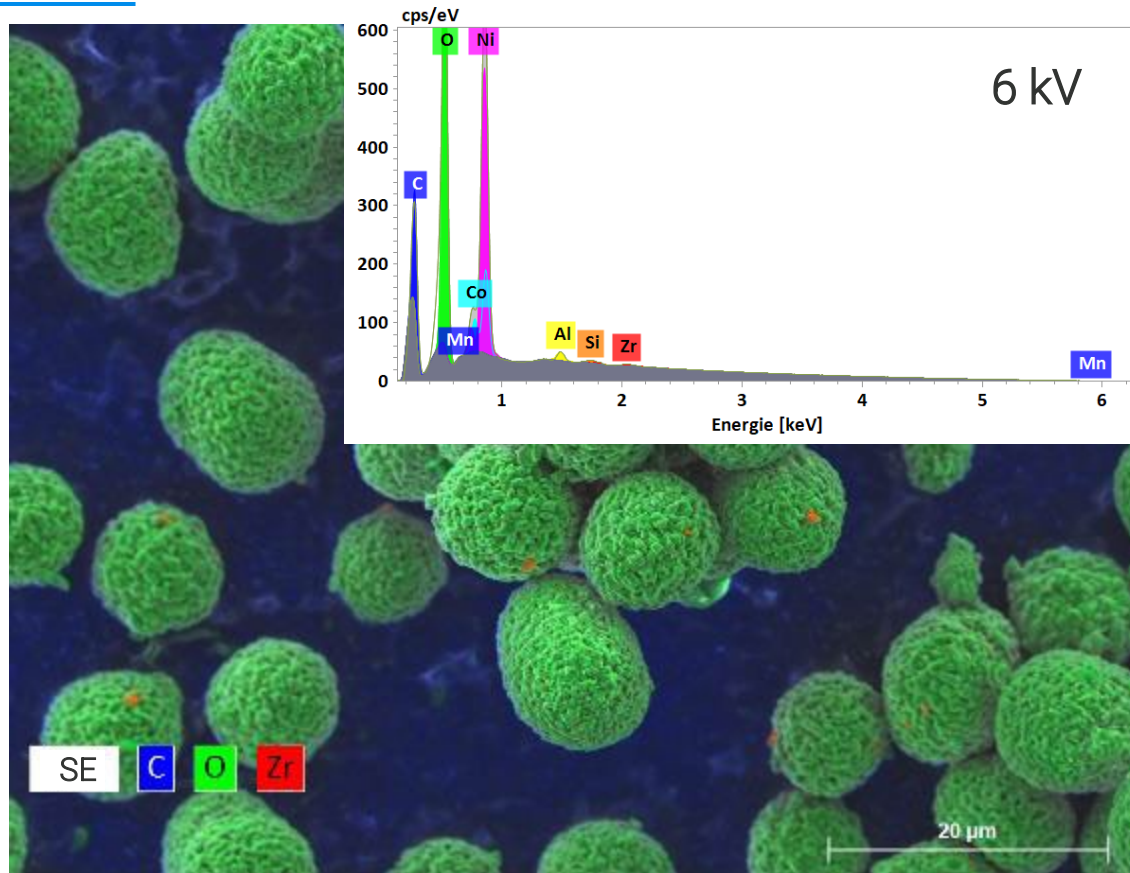
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# Sample probing: X-ray interaction volume in high-topography samples



# Choice of optimal acceleration voltage



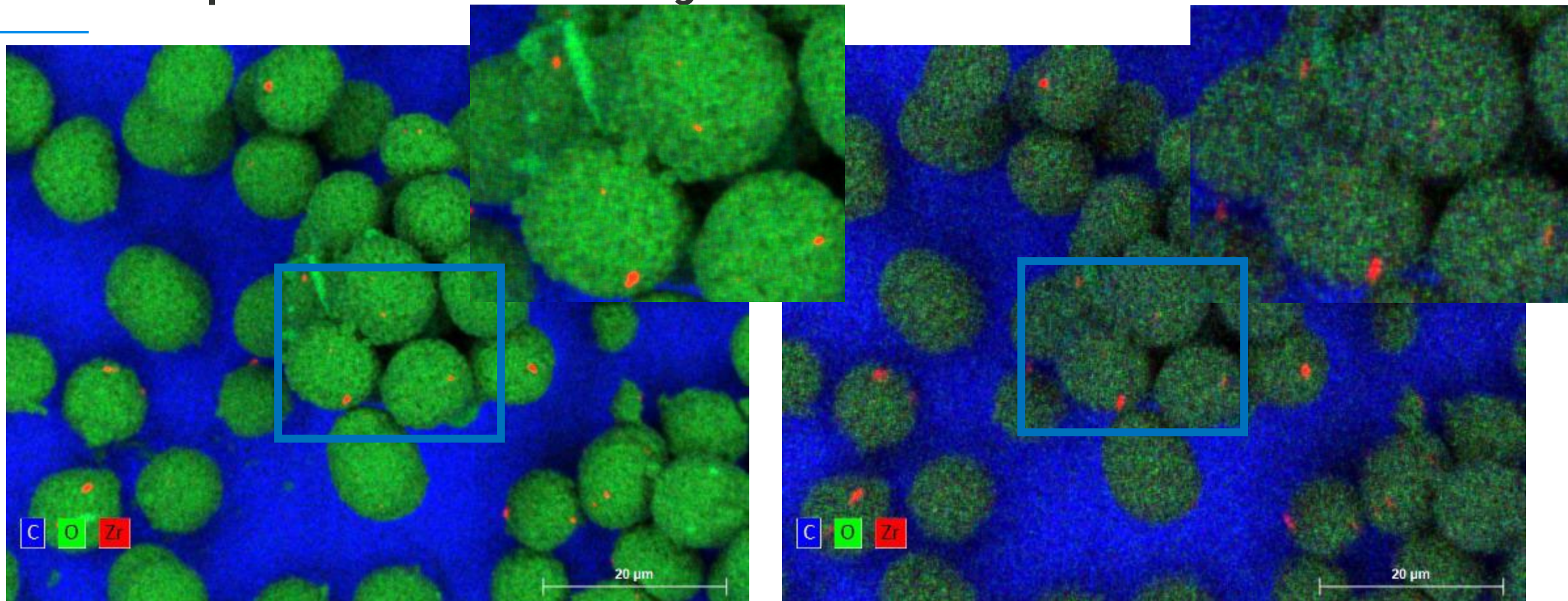
FlatQUAD 6 kV  
3 minutes

Lower kV ->

- better excitation of light elements (C, O)
- better spatial resolution due to smaller X-ray interaction volume

FlatQUAD 12kV  
3 minutes

## Choice of optimal acceleration voltage



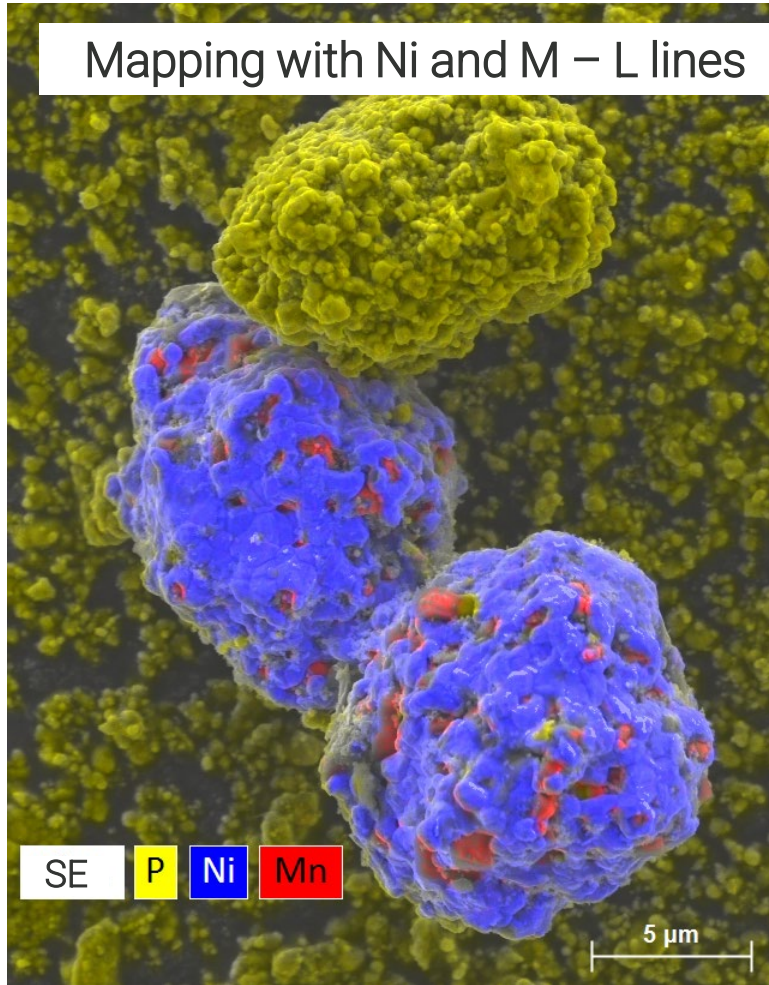
FlatQUAD 6 kV  
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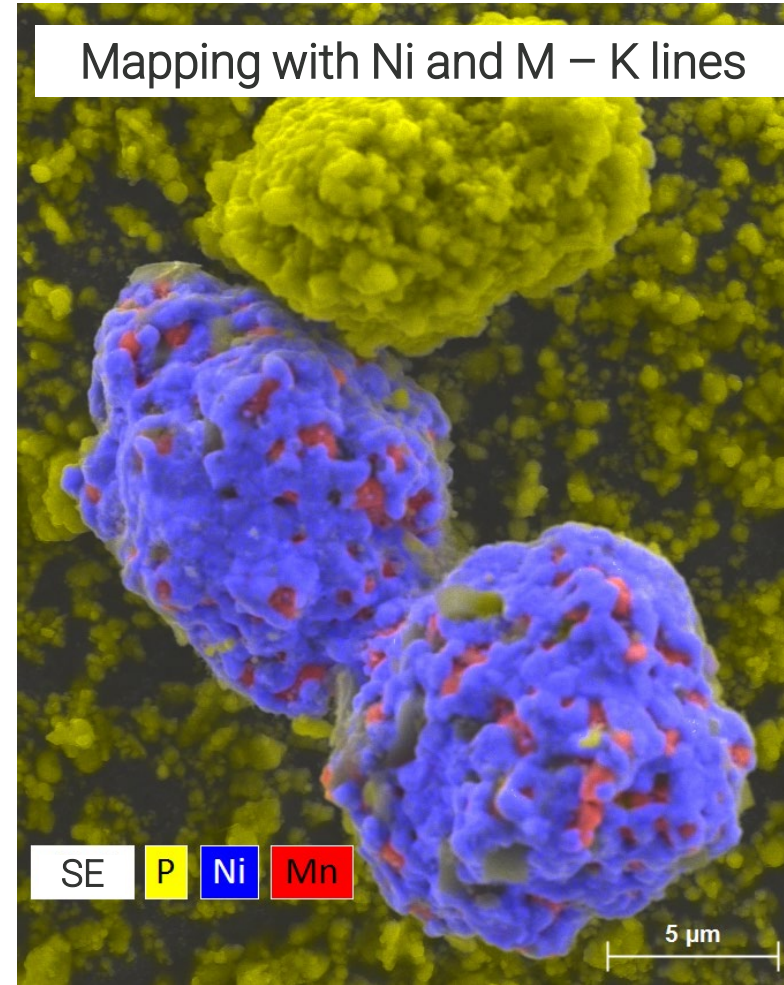
FlatQUAD 12kV  
3 minutes



# Choice of optimal acceleration voltage - $\text{LiFePO}_4$ and NCM particles



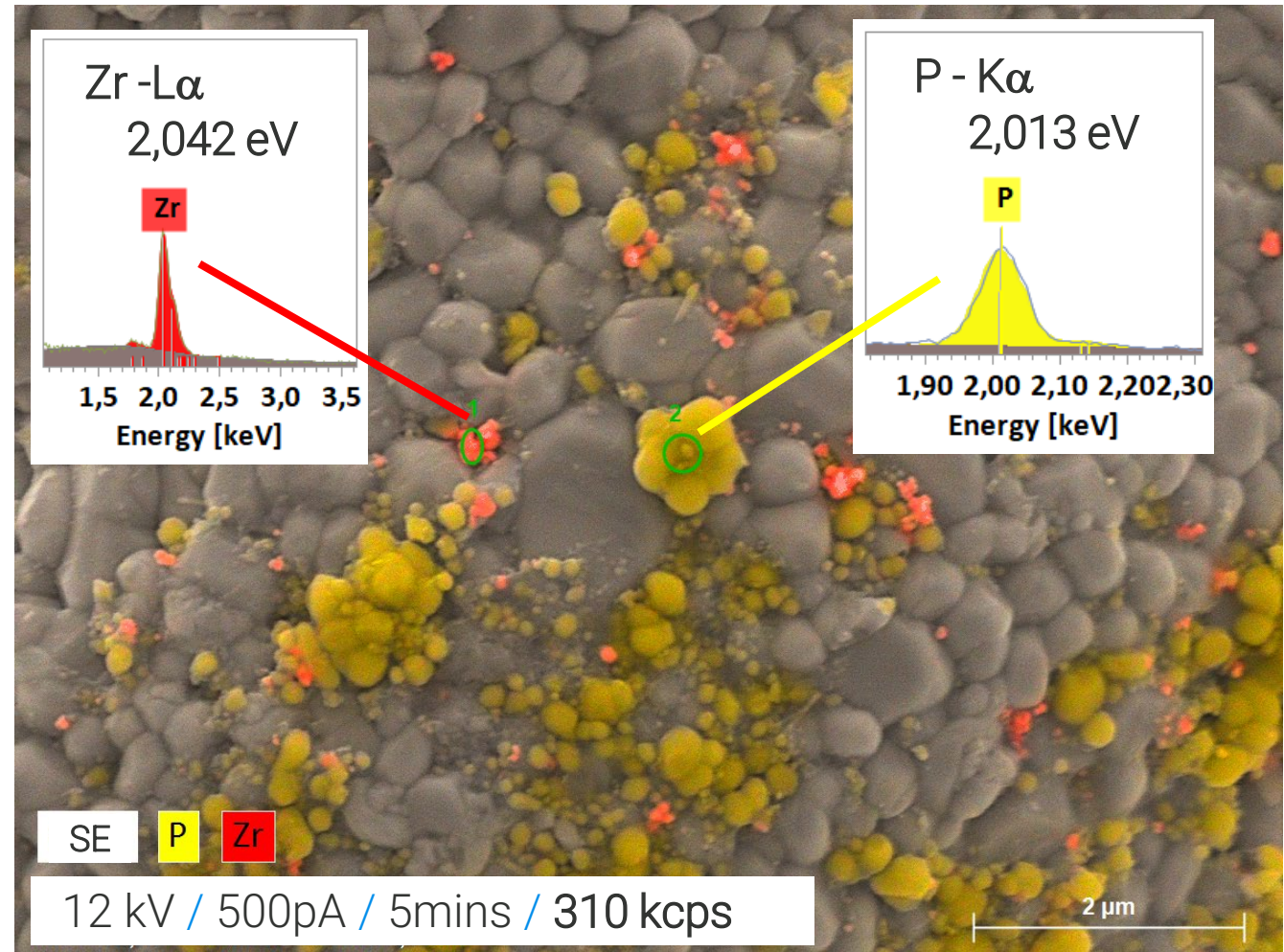
FlatQUAD, 6kV



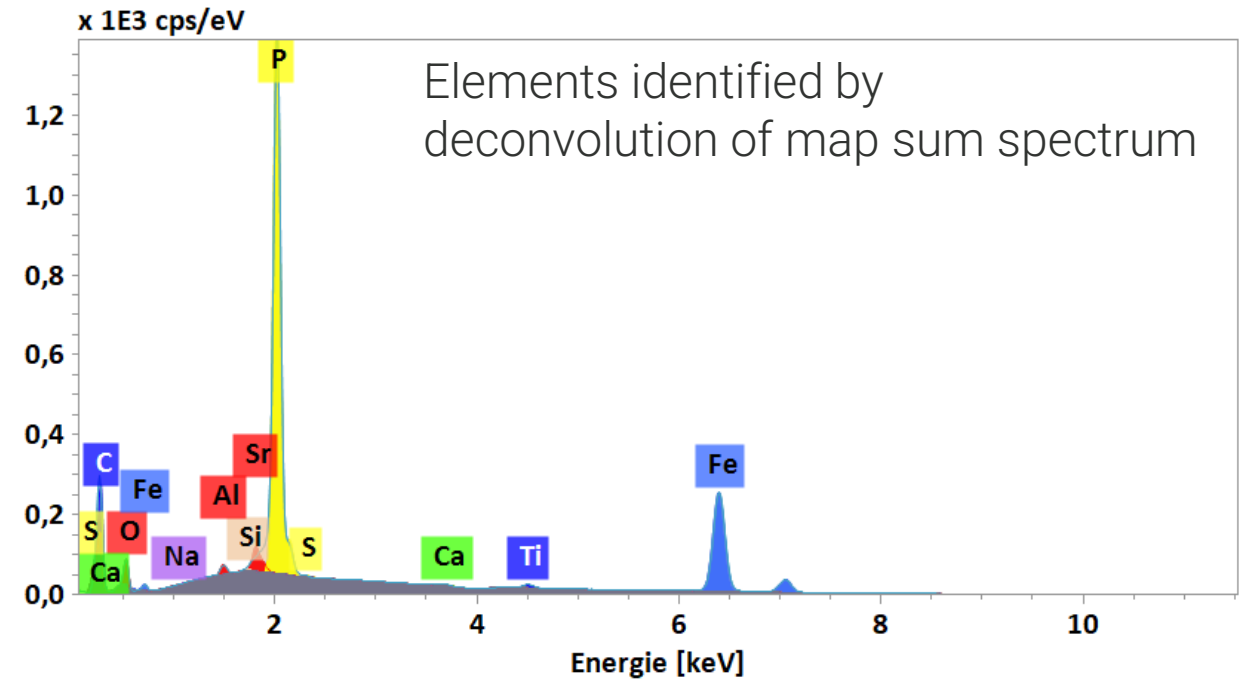
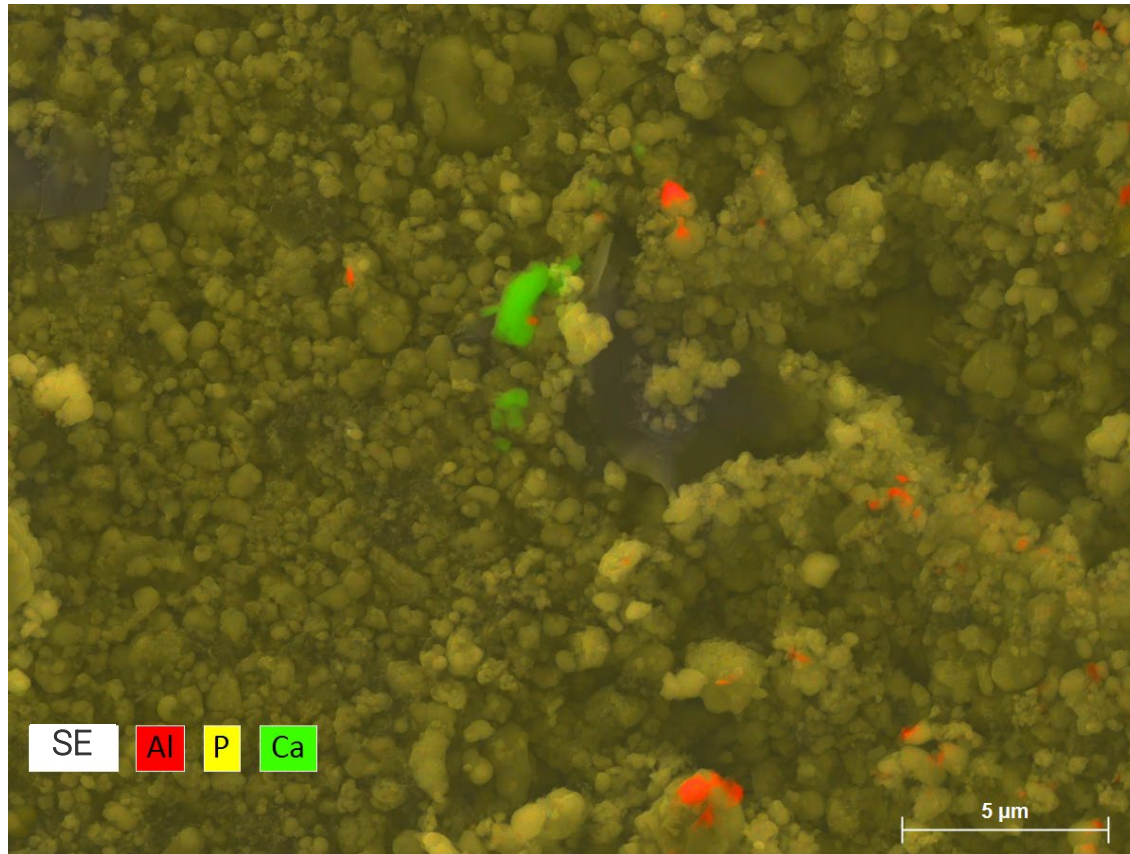
FlatQUAD, 12kV

## Separation of elements with overlapping peaks

- Is spectrum quality ok?  
Elements present with overlapping peaks:  
Phosphorus and Zirconium
- Deconvolution of extracted spectra prove presence of Zr and P
- Submicron sized P-containing and Zr particles can be distinguished based on their maps using online deconvolution



# CATHODE - identify and locate contaminants in very low concentration

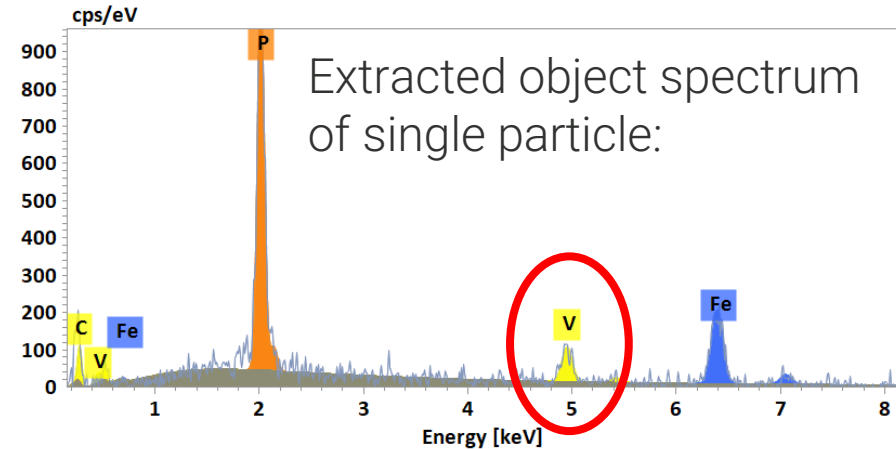
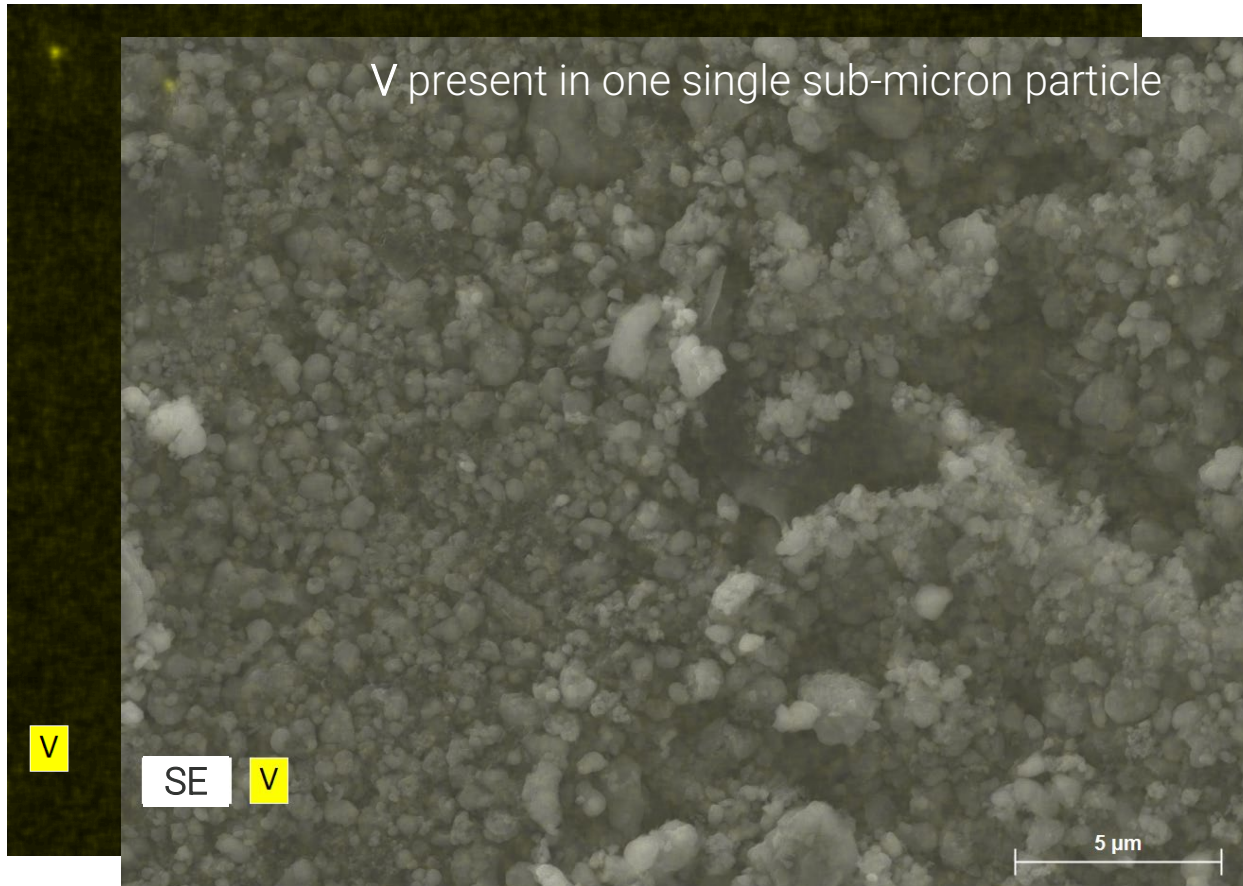


Area coverage= 0.01%

Local concentration of V: 11% -> 11 ppm V

Detected within 3 minutes of measurement time!

# CATHODE - identify and locate contaminants in very low concentration



Element	At. No.	Line series	Mass Norm. [%]	Atom [%]
C	6	K	6,02	19,63
P	15	K	24,35	30,79
V	23	K	11,43	8,79
Fe	26	K	58,19	40,80
			<b>100,00</b>	<b>100,00</b>

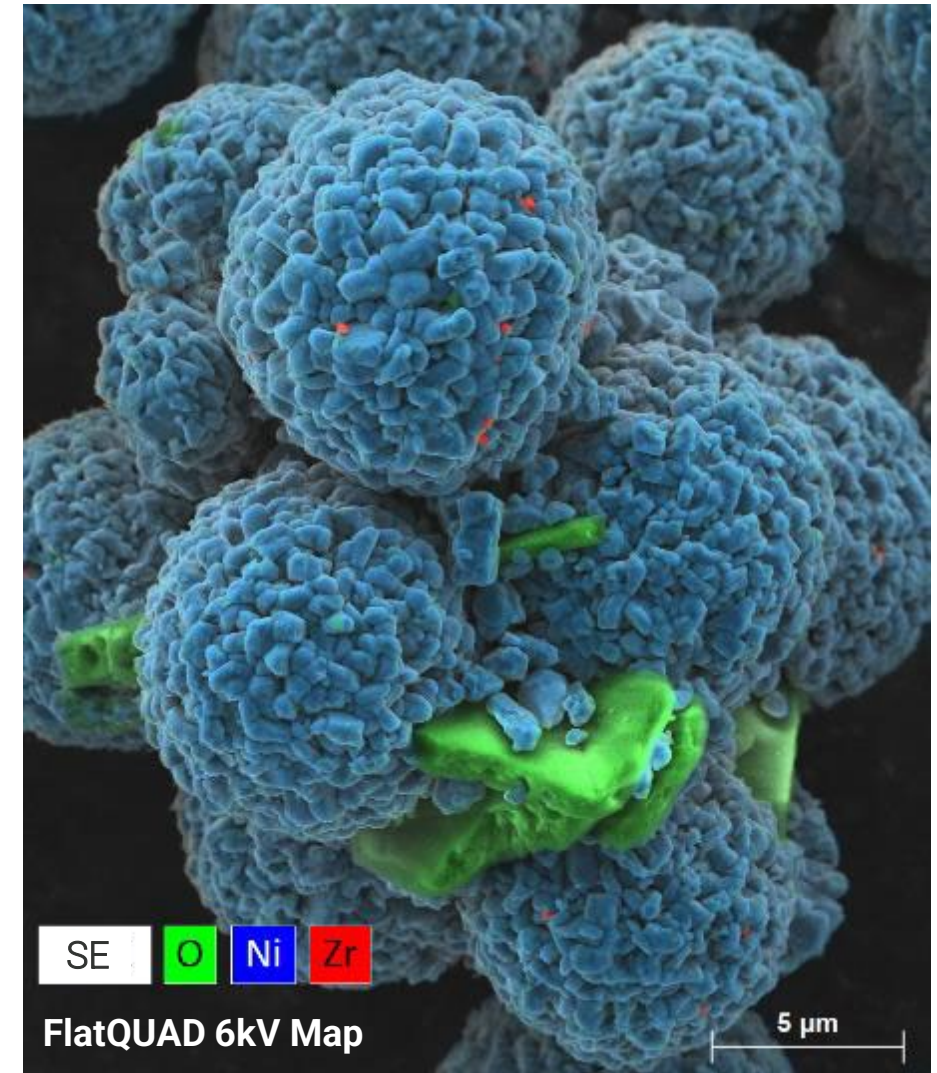
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## Summary – Application examples of FlatQUAD

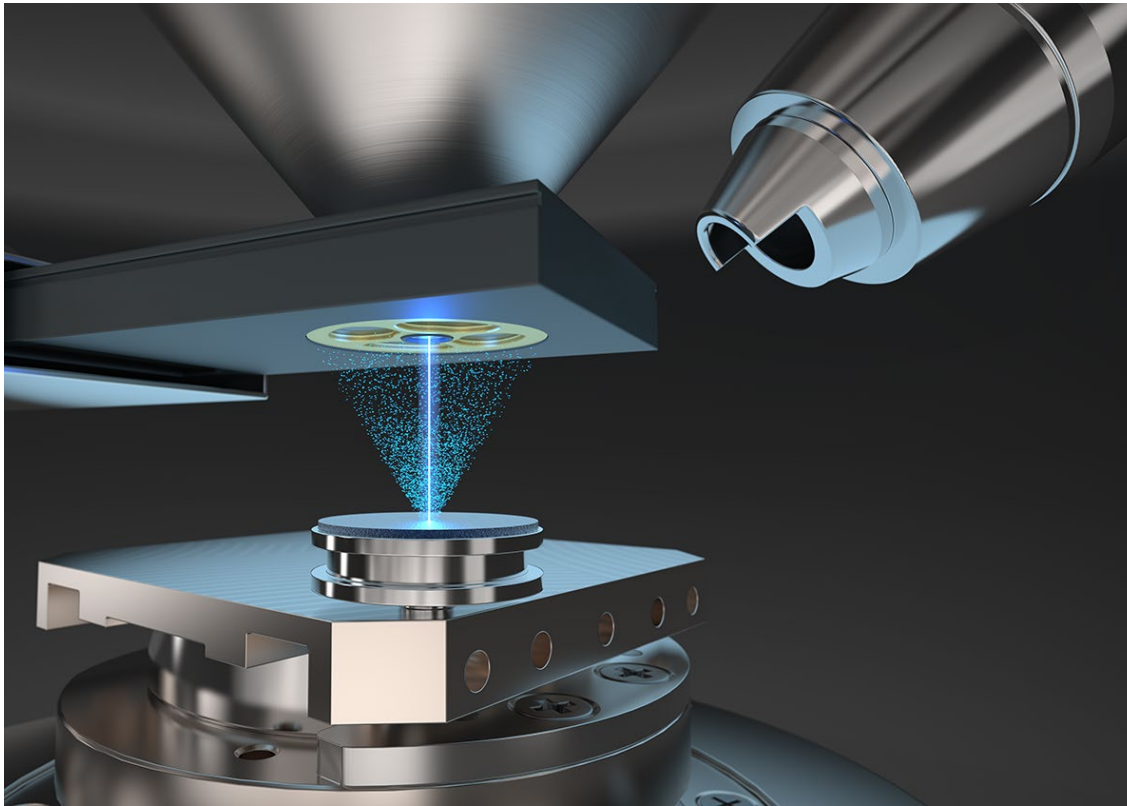
- FlatQUAD vs. conventional EDS detector:
  - Faster mapping
  - No shadowingMore information
- Choice of optimal acceleration voltage  
Improve spatial resolution / sufficient excitation of element lines
- Proof of spectrum quality:  
overlapping element peaks: peak or online deconvolution
- High sensitivity allows detection of contaminants in short time.



## QUANTAX FlatQUAD - Questions & Answers

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Please type your questions in the Q&A window and press ENTER



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- 4 x higher maximum processing speed
- 2 x higher take-off angle
- Same spectral performance

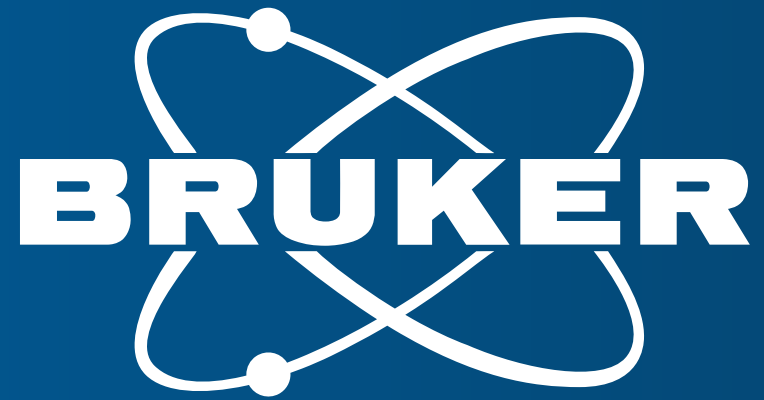


# Thank you!

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Innovation with Integrity