

# Efficacy of ozone cleaning of SrTiO<sub>3</sub> substrates for molecular beam epitaxy

# Acknowledgements

Principal Investigator:



Jenny Hoffman

Mentor:



Tatiana Webb

Funding and Resources:



## Outline

- Importance and challenges of cleaning STO for MBE
- Efficacy of ozone cleaning over varying parameters
- Systematic errors in measurement of carbon reduction

# Substrate cleanliness is critical for MBE

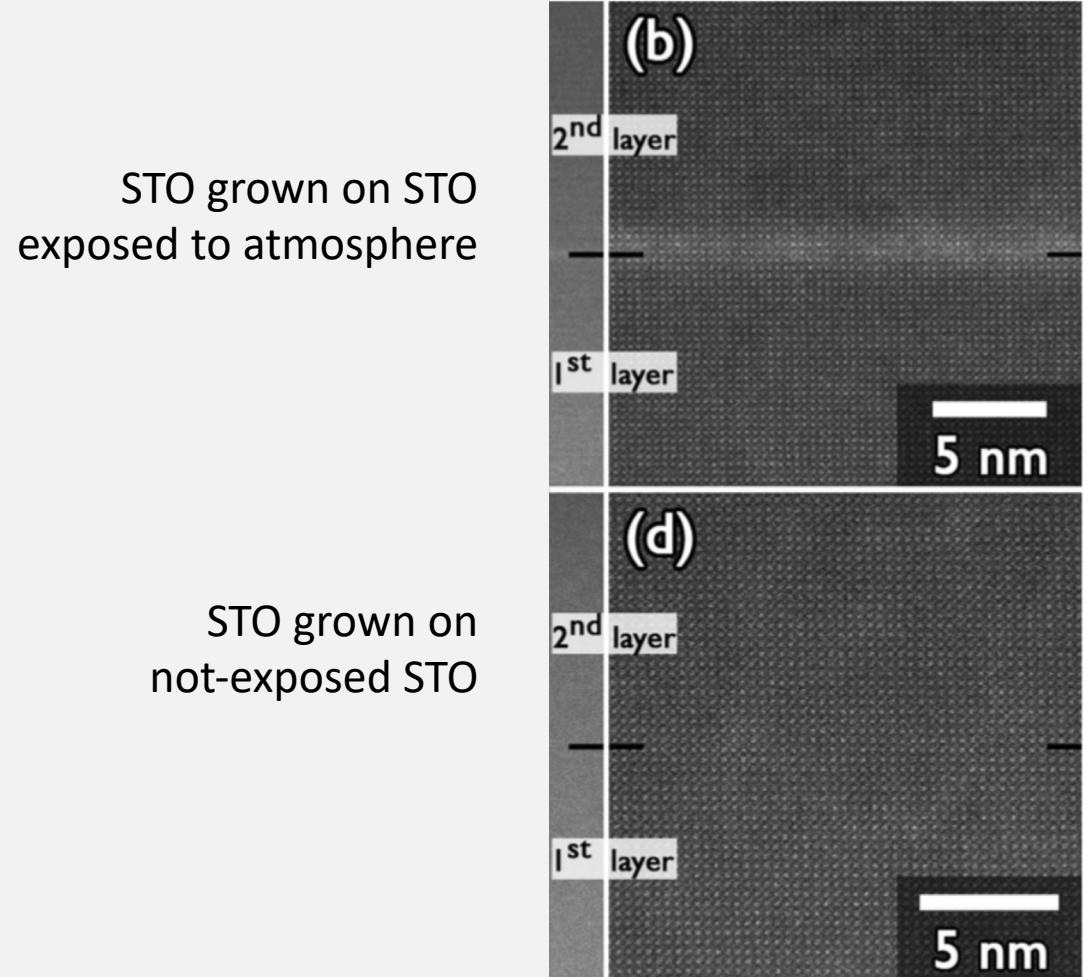


Image: Jalan, Journal of Vacuum Science & Technology A 27, 1365 (2009)

# Substrate cleanliness is critical for MBE

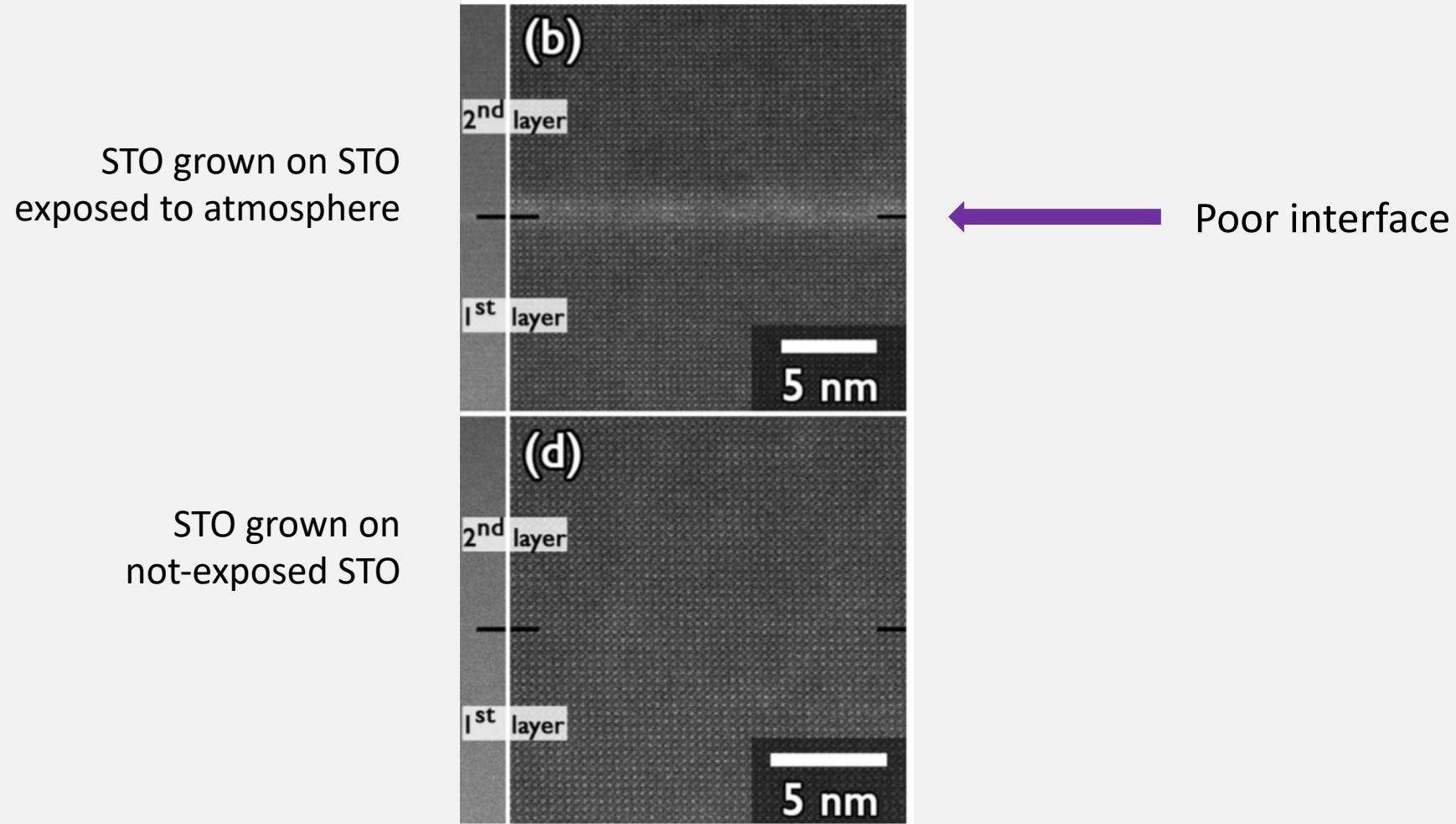
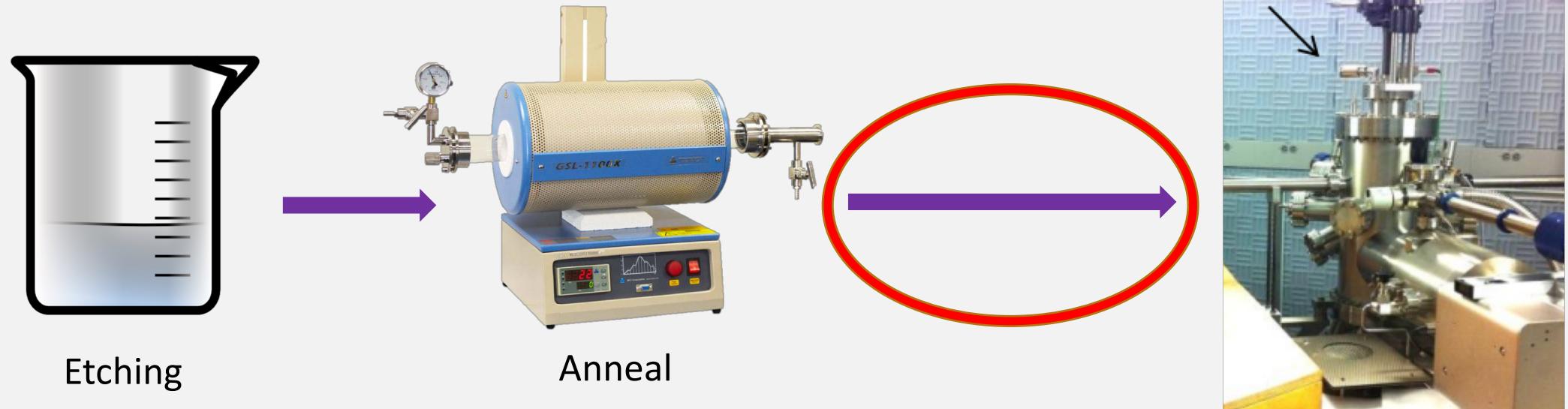


Image: Jalan, Journal of Vacuum Science & Technology A 27, 1365 (2009)

# Cleanliness is complicated by ex-situ preparation



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# Ex-situ cleaning solutions can reduce carbon

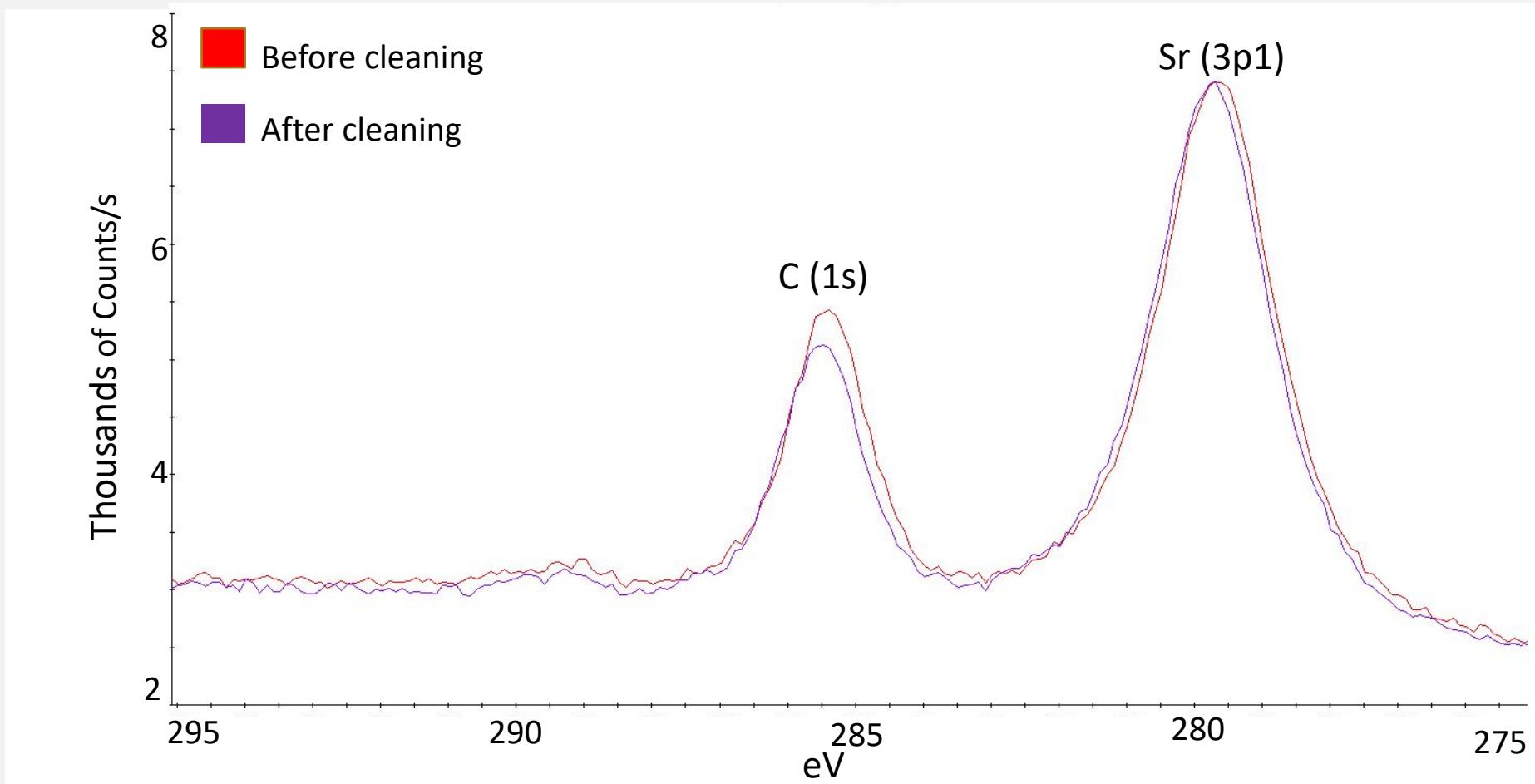
## Ozone Cleaning

- UV light and O<sub>3</sub> create O\*
- O\* interacts with carbon contamination to form hydrocarbons which desorb

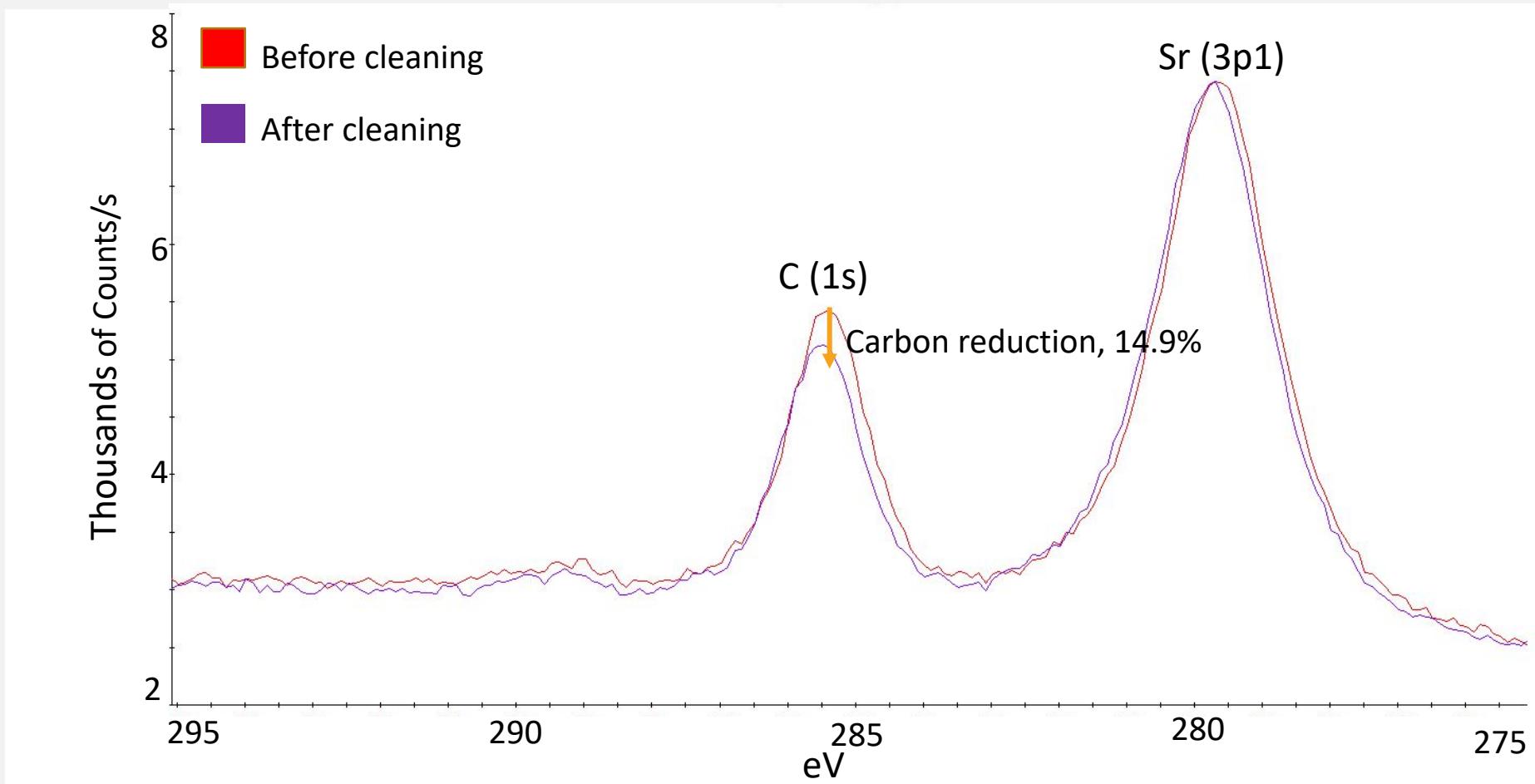


UVFAB Helios-500

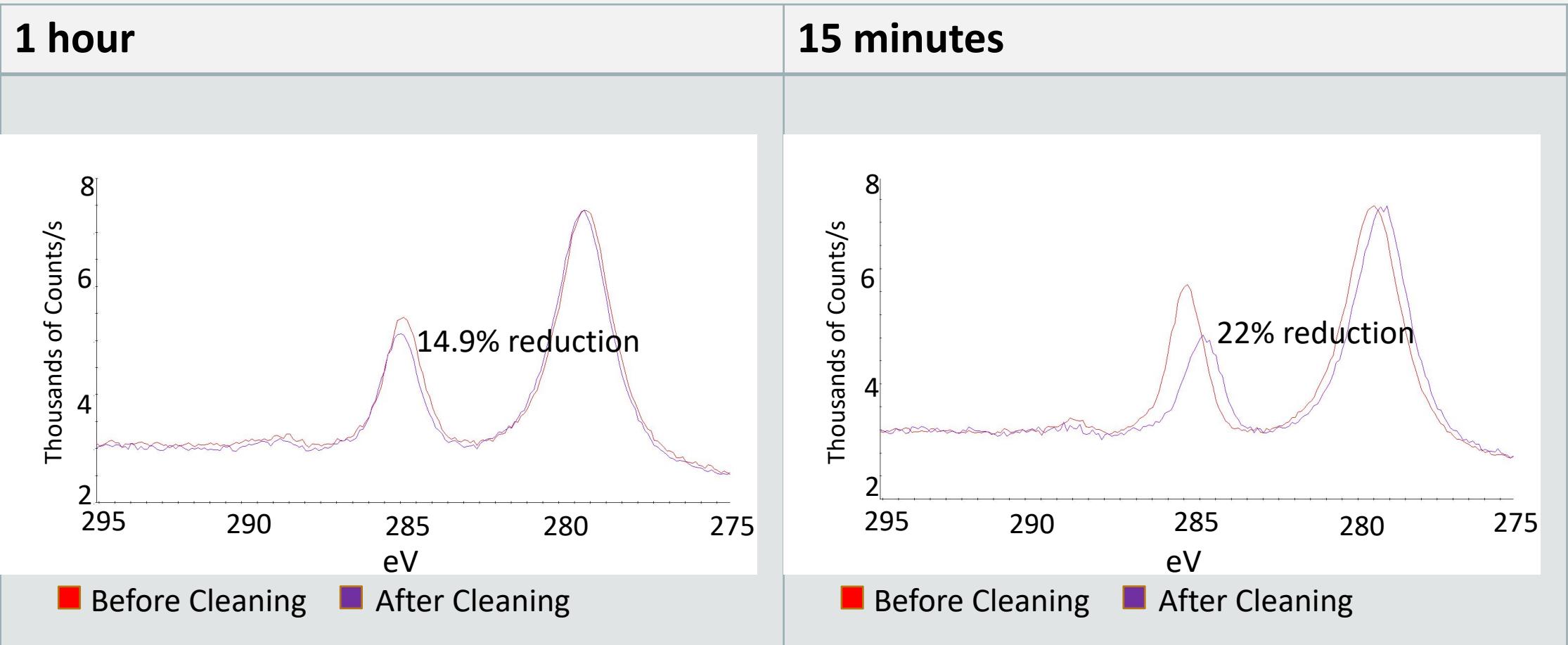
# Carbon is reduced by ozone cleaning



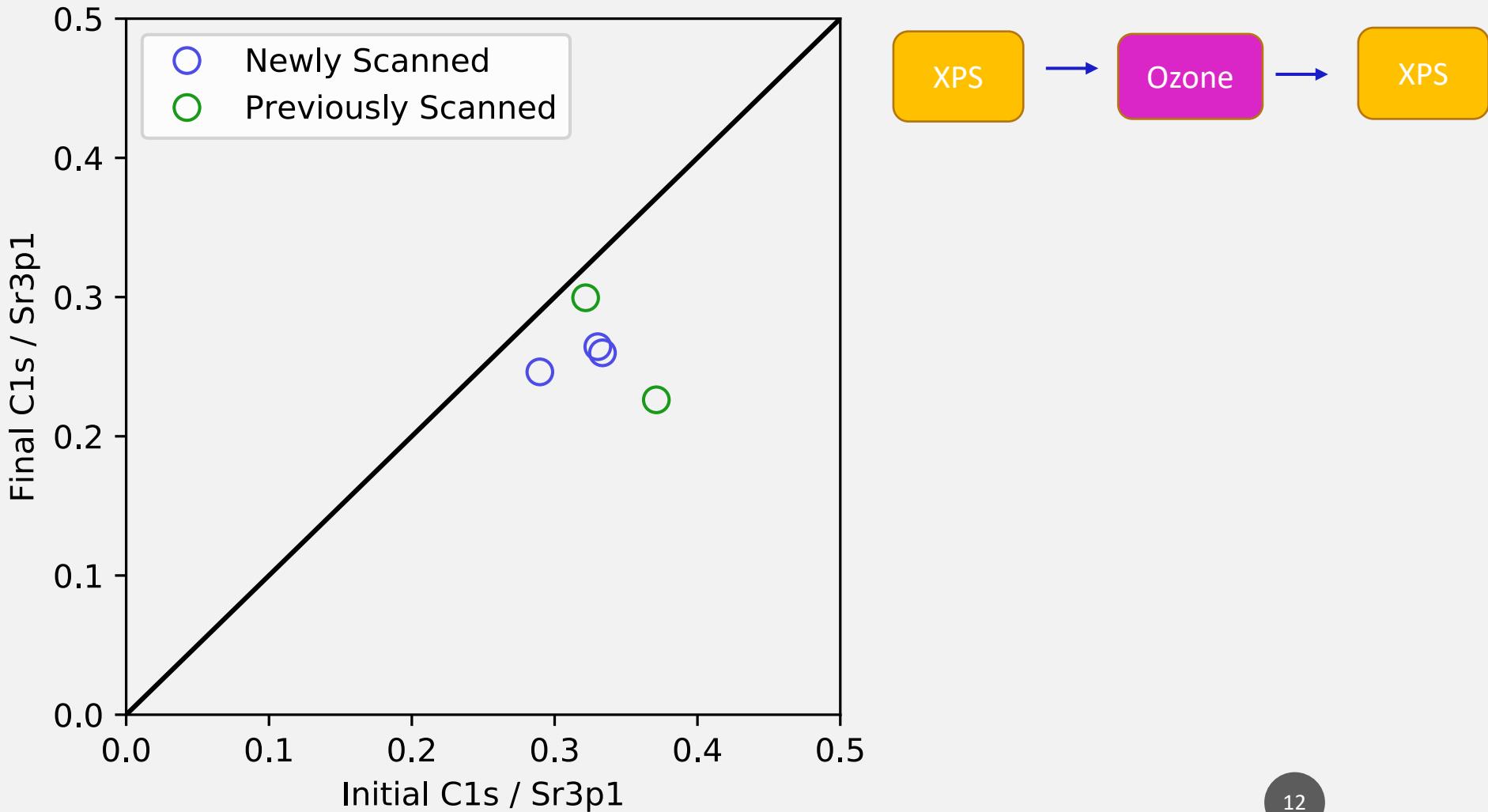
# Carbon is reduced by ozone cleaning



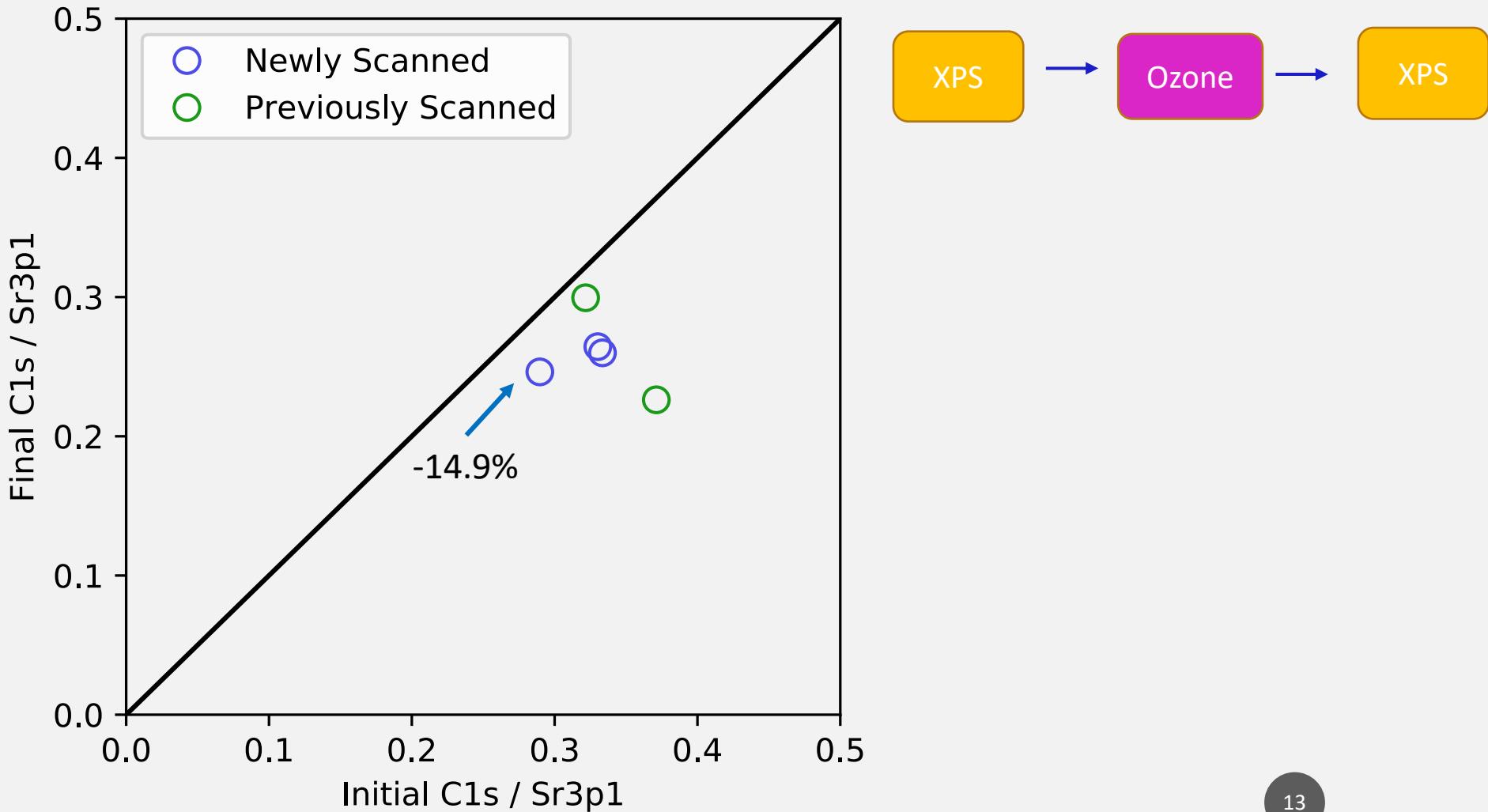
# Longer cleaning procedures are not more effective



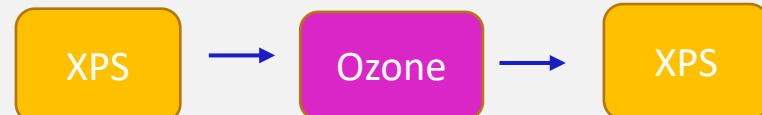
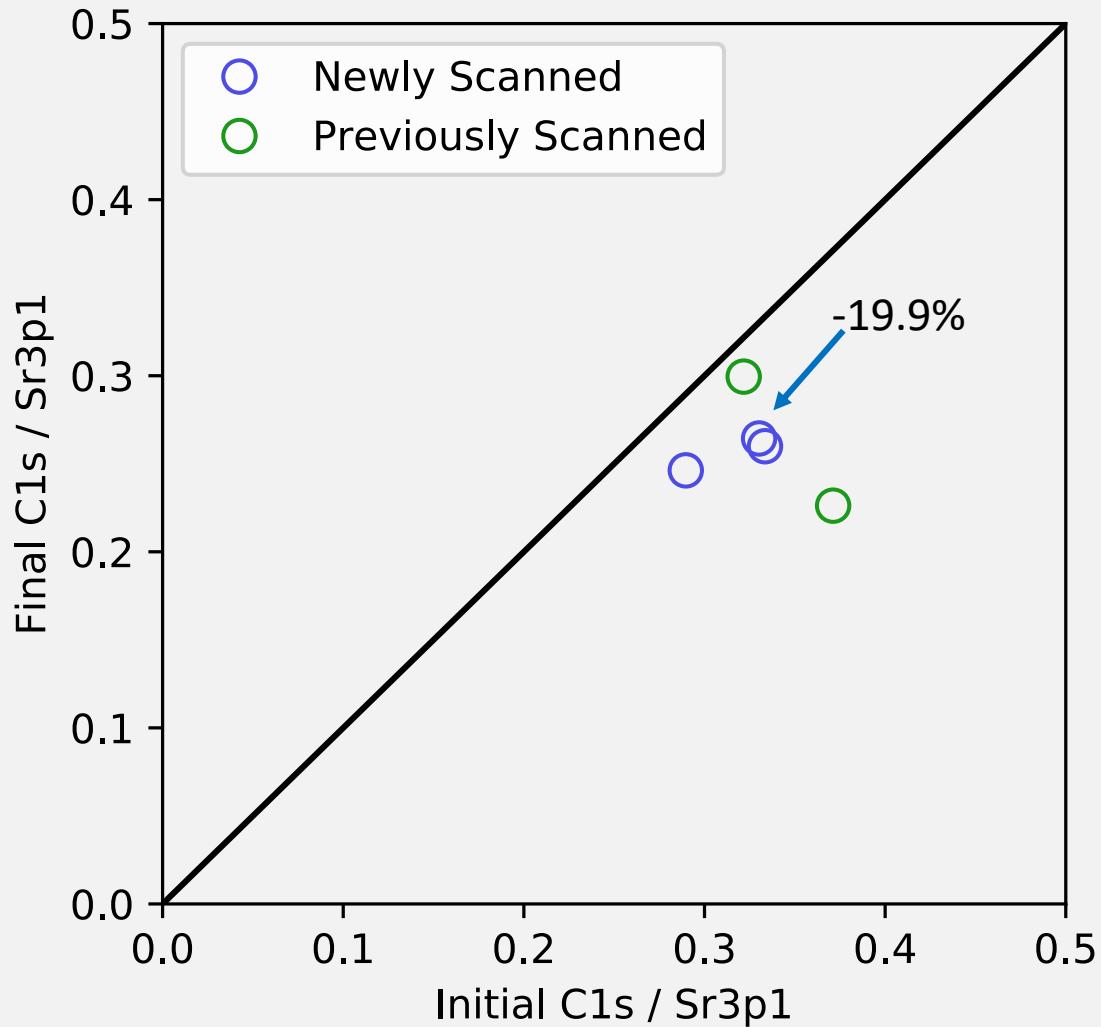
# Ozone Cleaning Causes Carbon Reduction



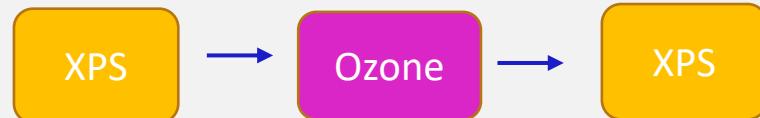
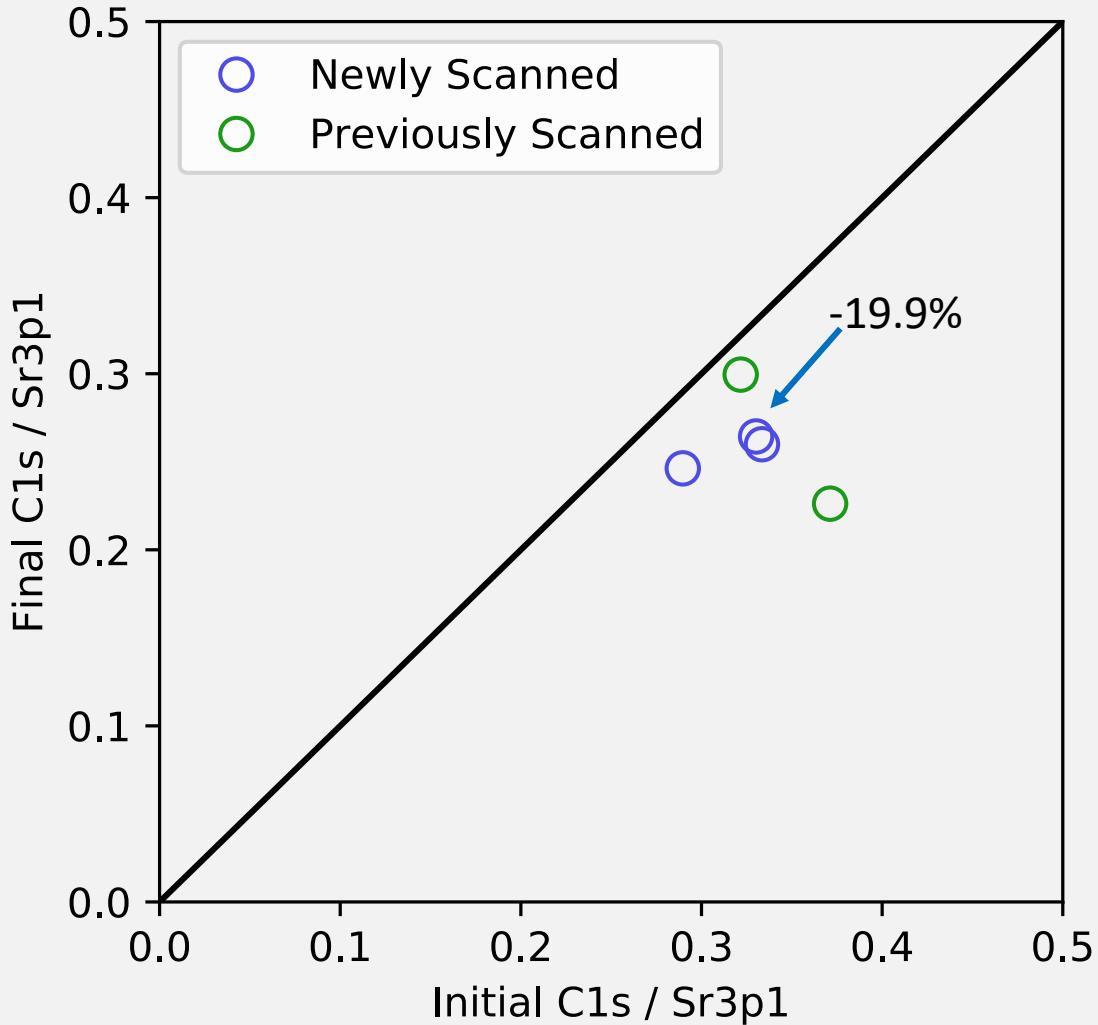
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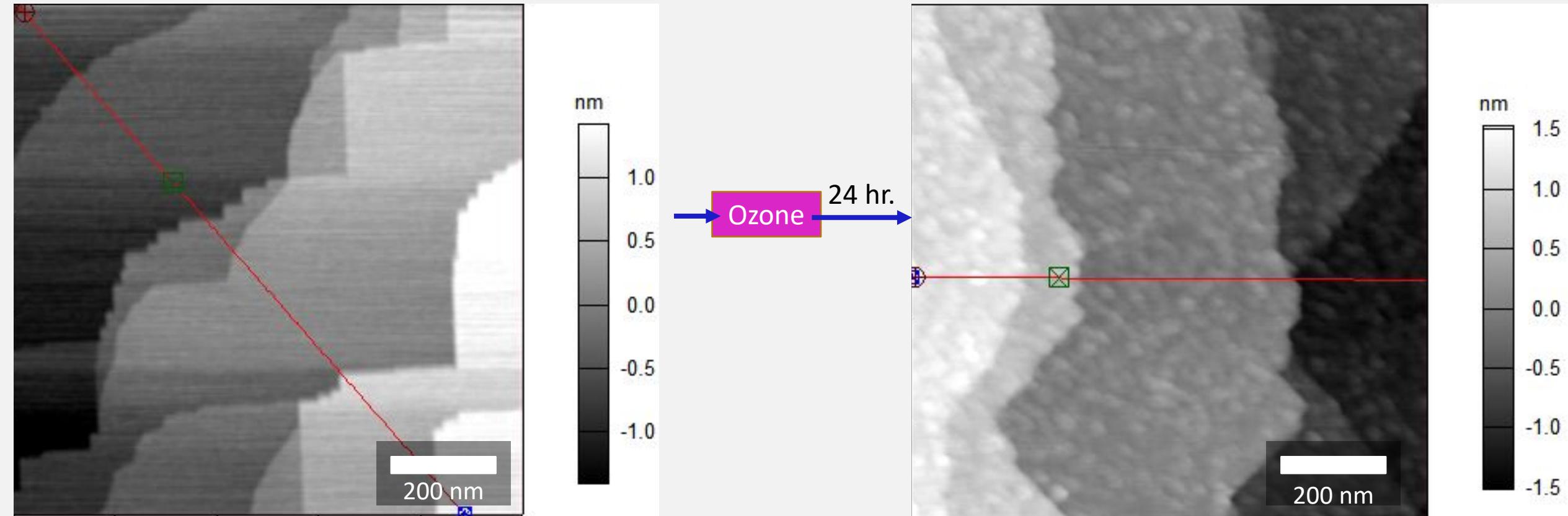


# Ozone Cleaning Causes Carbon Reduction

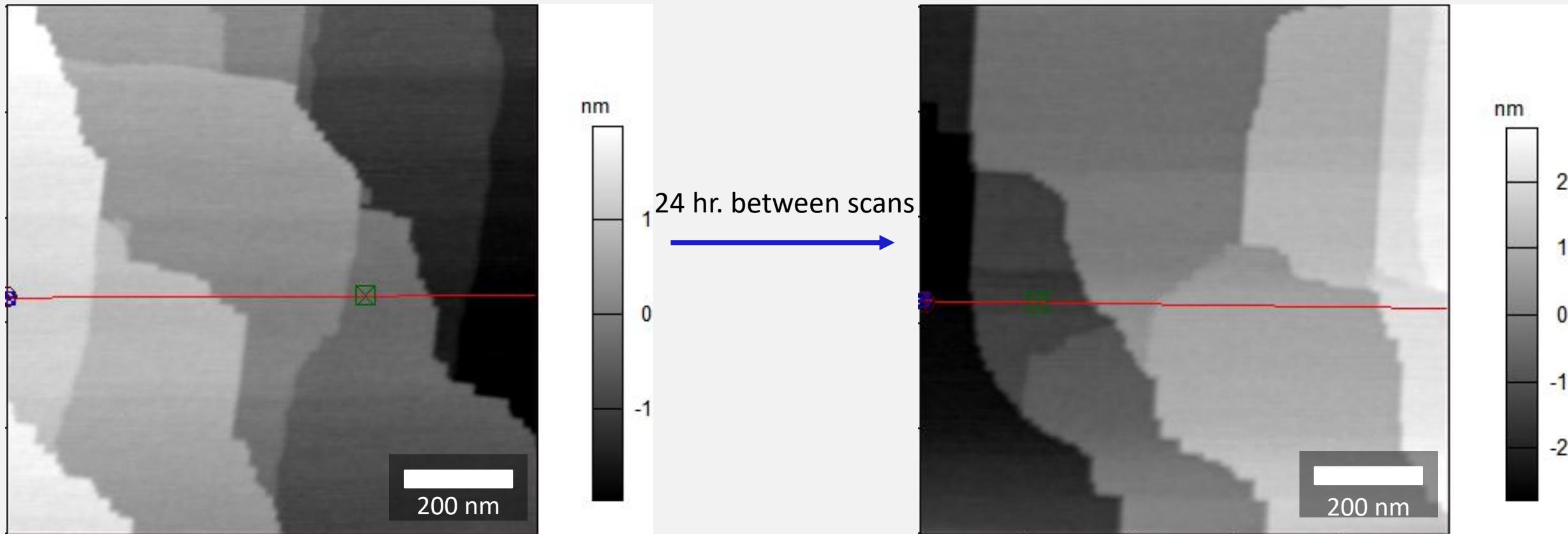


Average of 19.0%  
carbon reduction

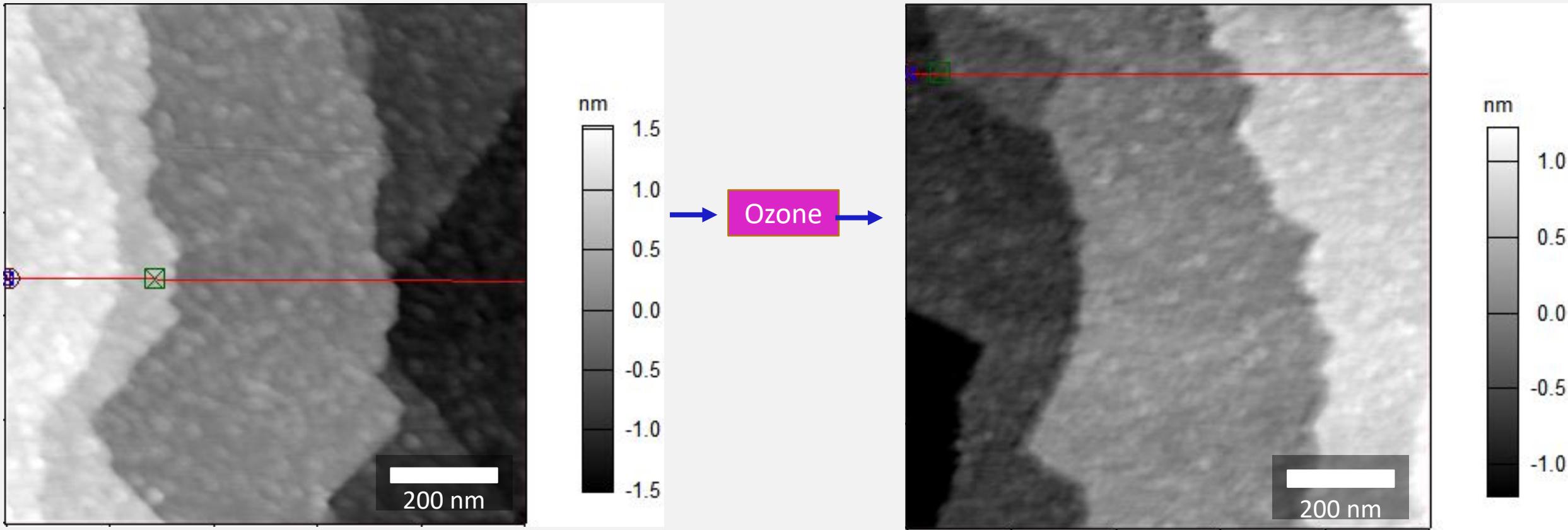
# Contamination is visible by AFM after 24 hours



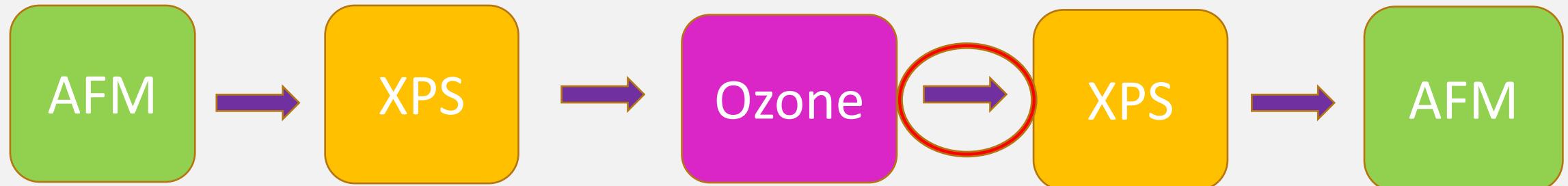
## Contamination not visible on uncleaned samples



# AFM-visible contamination is not removable



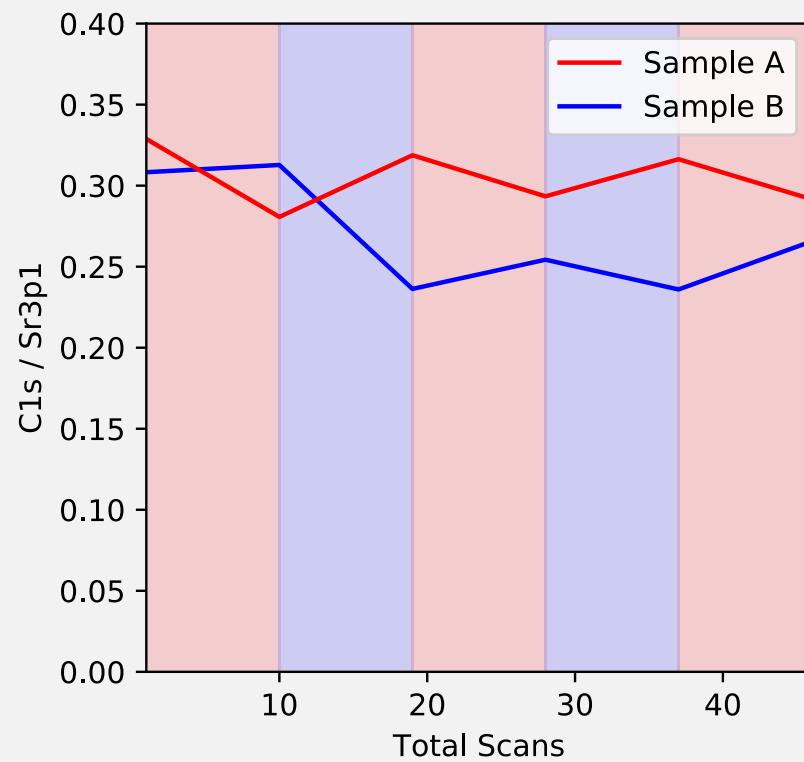
## Systematic error: sample transfer



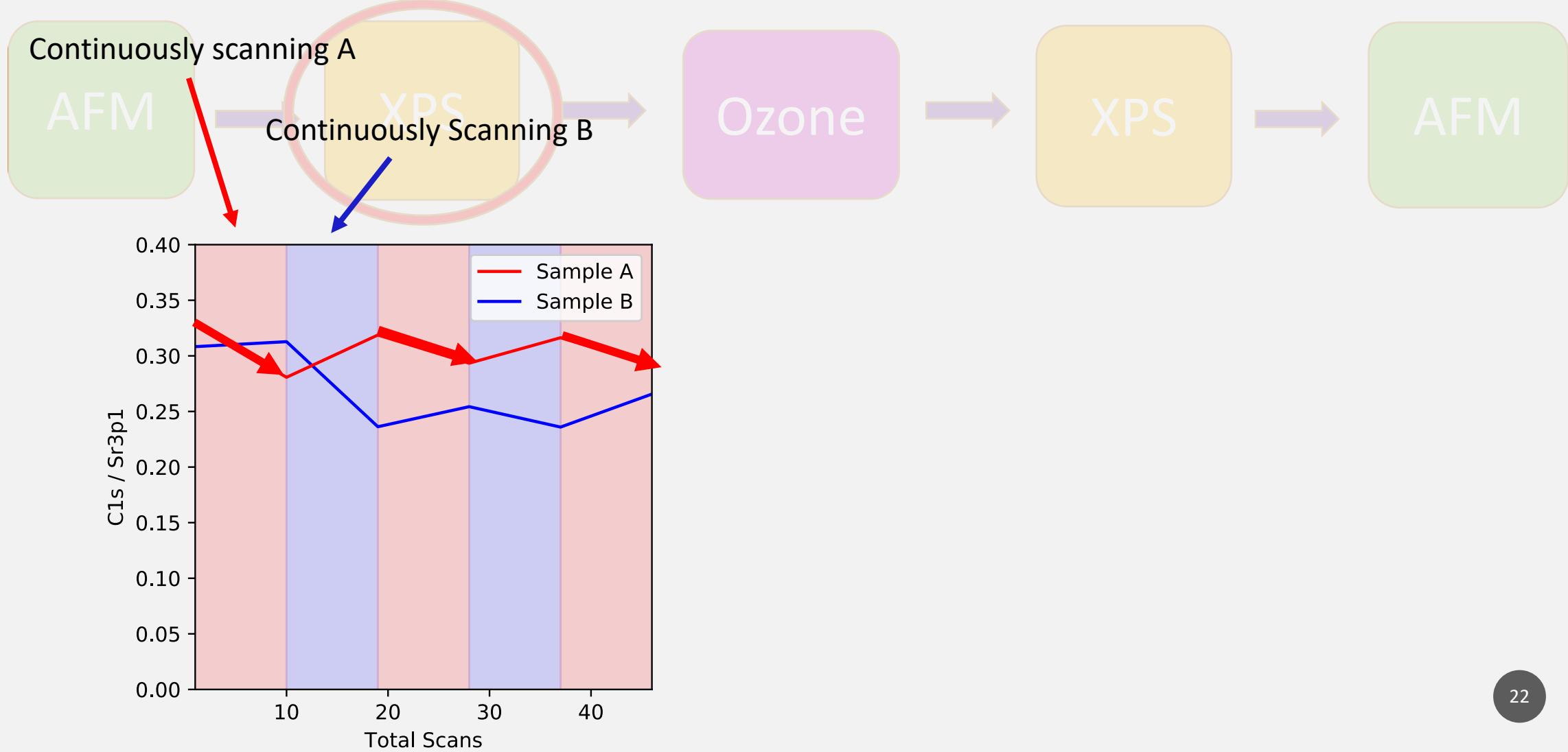
## Systematic error: XPS



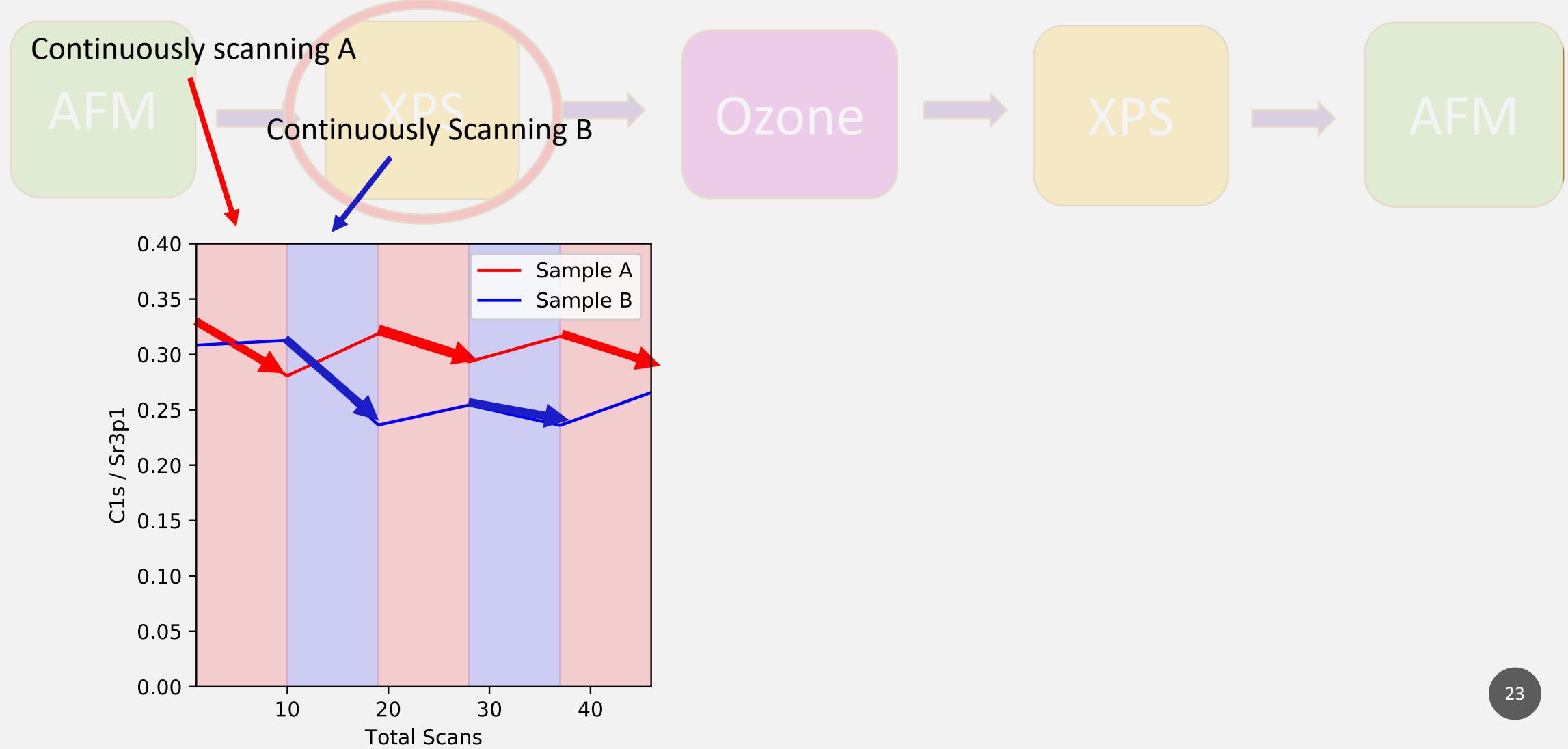
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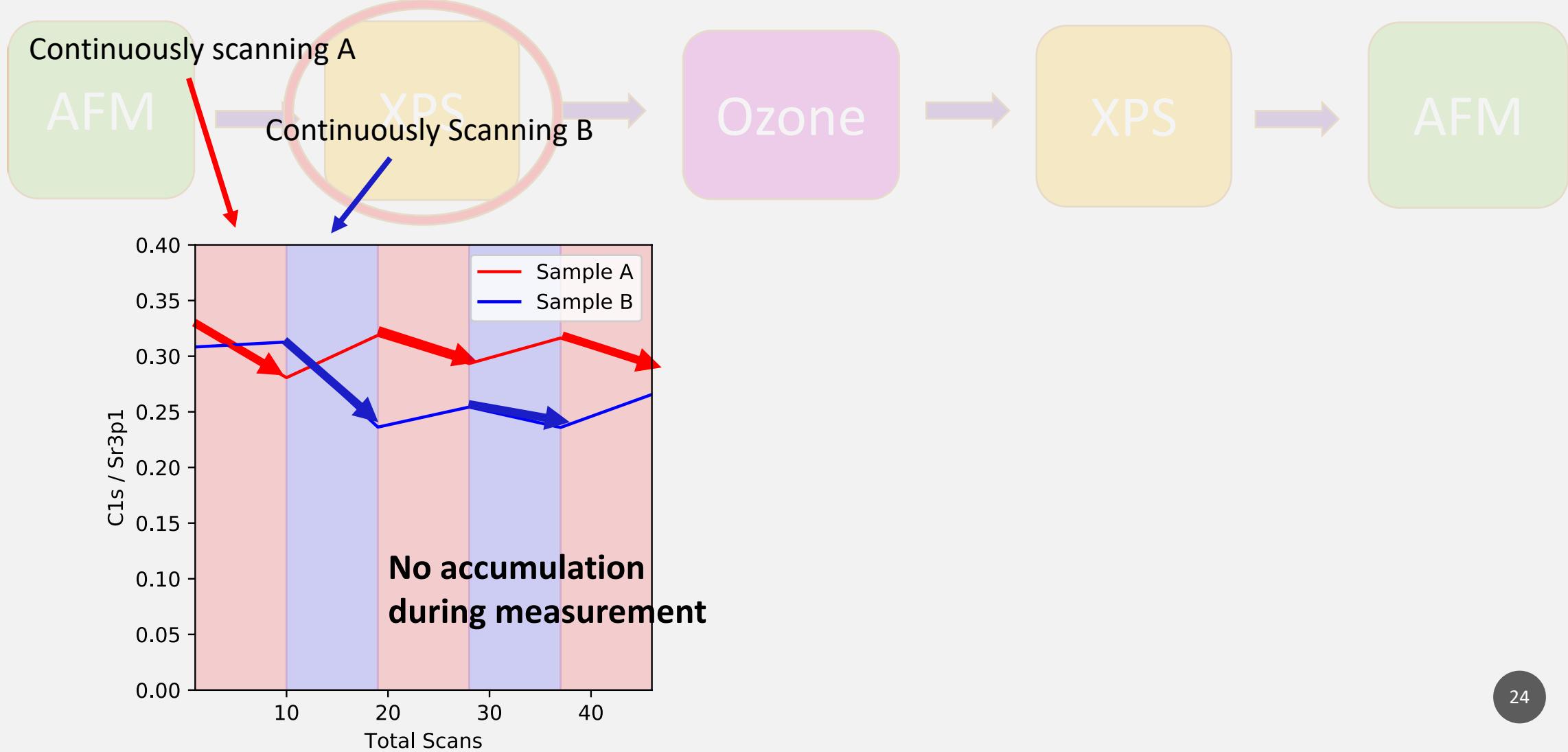
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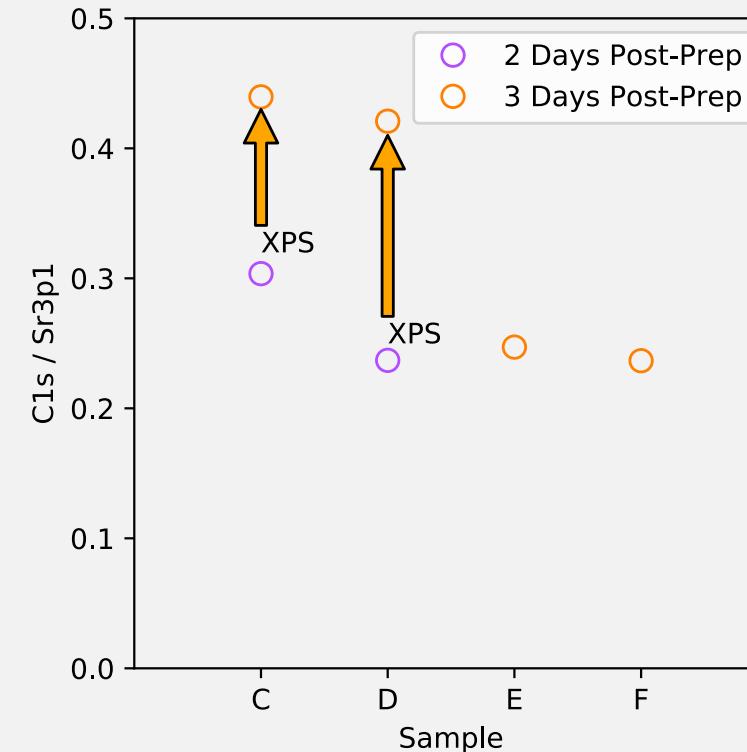
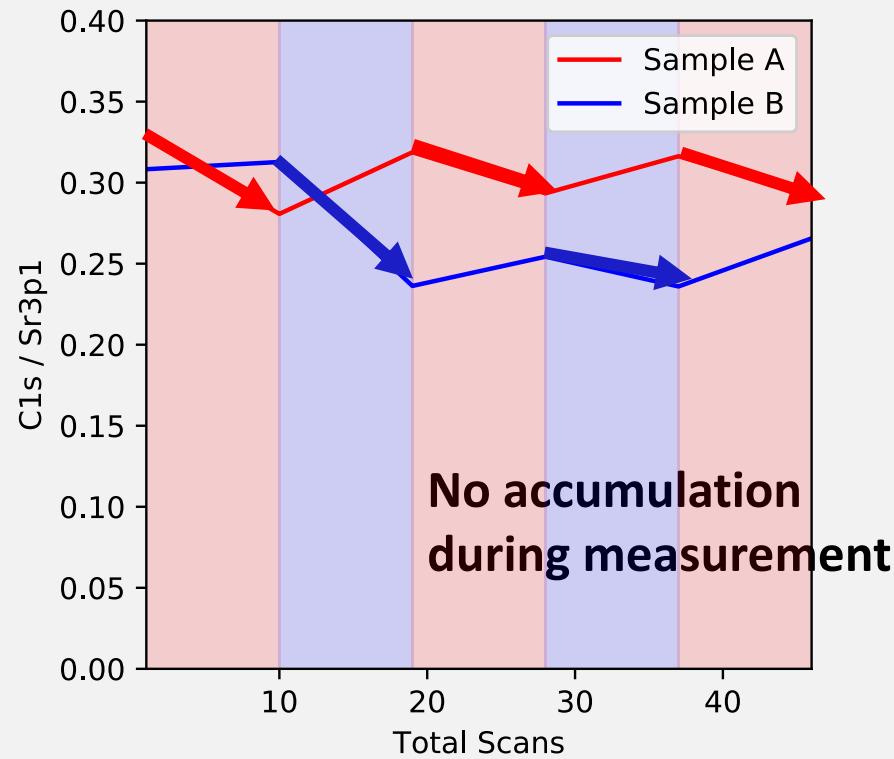
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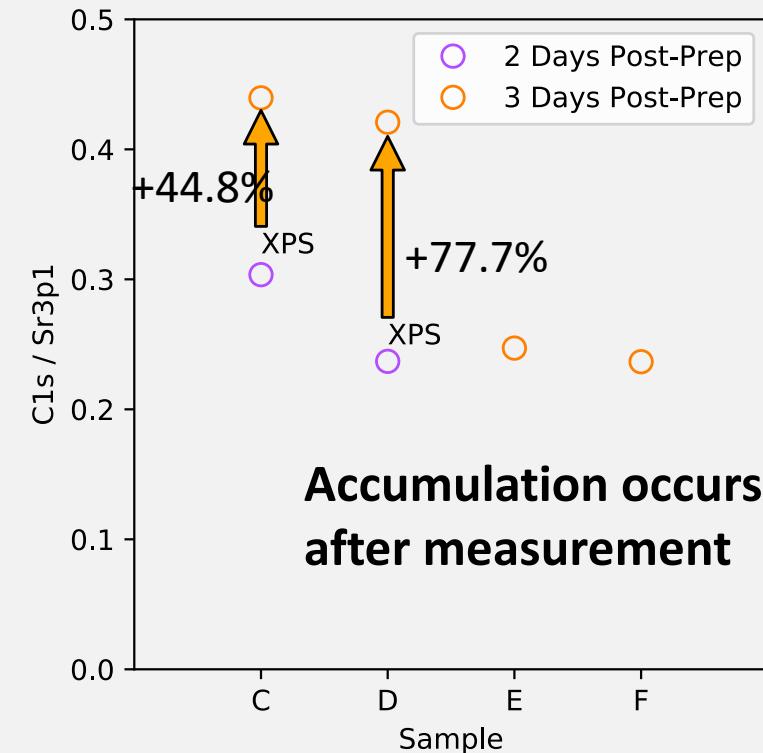
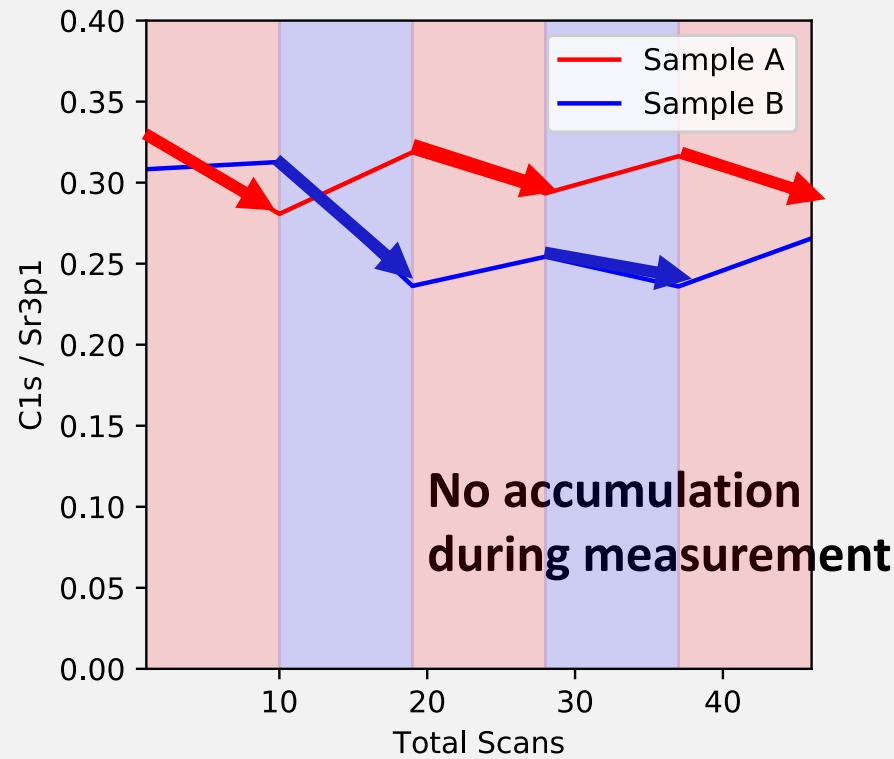
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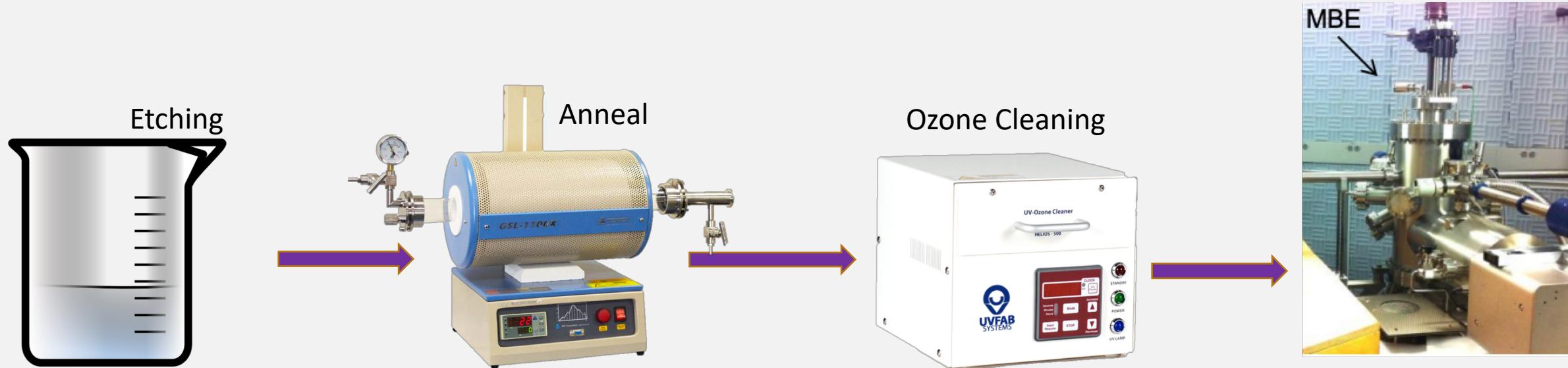
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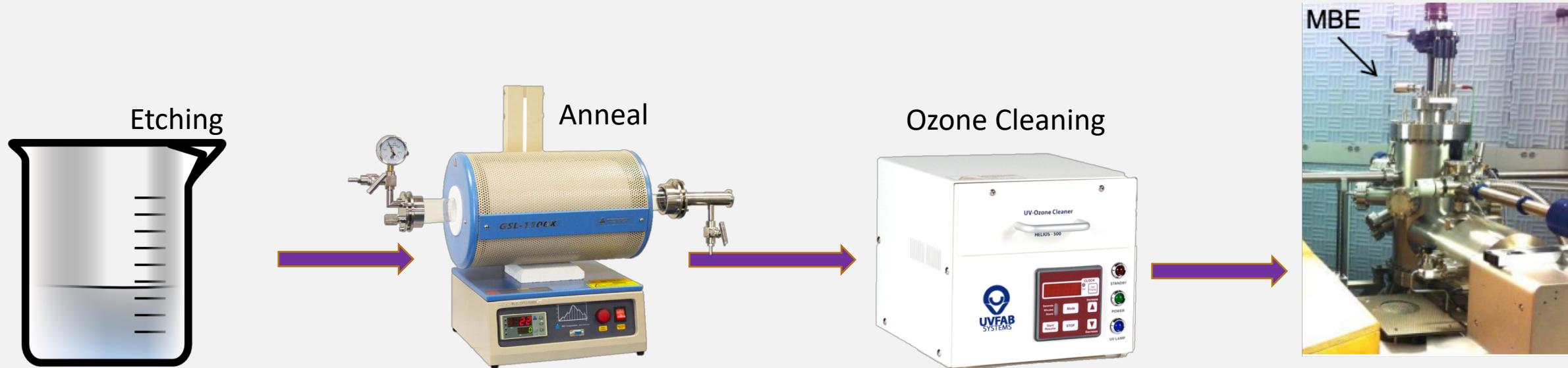


# Recommendations



Measured 19% carbon reduction

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Thank you!