# Chemical Mapping of Individual Atmospheric Nanoparticles

**Kamal Raj R[1], J. J. Lin[1], H. Yuzawa[2], T. Ohigashi[2], and N. L. Prisle[1]**

[1]Center for Atmospheric Research, University of Oulu, Finland [2]UVSOR Synchrotron, Institute for Molecular Science, Japan

## Introduction

- Particles suspended in the Earth's atmosphere has profound impact on global climate and air quality.[1]
- The numerous effects of atmospheric particles are fundamentally governed by their chemical composition and structure, which are scarcely characterized.
- Traditional single particle analysis technique like AMS cannot provide structural information of individual particles or spatial distribution of individual molecular components within particles.
- Scanning Transmission X-ray microscopy (STXM) provide both structural information and chemical composition of submicron deposited particles.
- We present the results from STXM measurements carried out on three different atmospherically relevant sample systems.

## Experimental method

- STXM measurements at BL4U beamline, UVSOR III, Japan.
- Energy range: 75-1000 eV, E/ΔE ~6,000 at exit slit size of 30 µm
- Recorded images at C, Ca, and S edges.
- Multivariate ANalysis Tool for Spectromicroscopy (MANTiS) and aXis 2000 used for cluster analysis and spectral extraction.

**Presenting author: Kamal Raj R**
Kamal.RajR@oulu.fi

I am a doctoral student studying the surface properties of atmospherically relevant aerosols using synchrotron-based spectroscopic techniques. Here, I showcase the feasibility of using STXM to study the composition and origin of atmospherically relevant nanoparticles and present the initial results.

## Samples

- Laboratory generated model aerosol sample.
- Urban aerosol samples.
- Microscopic plastic samples.

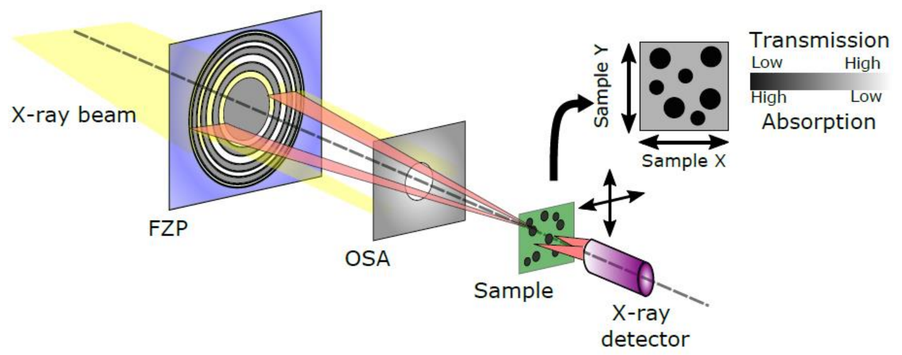


Fig 1. Schematics detailing the principle of STXM measurements[2]

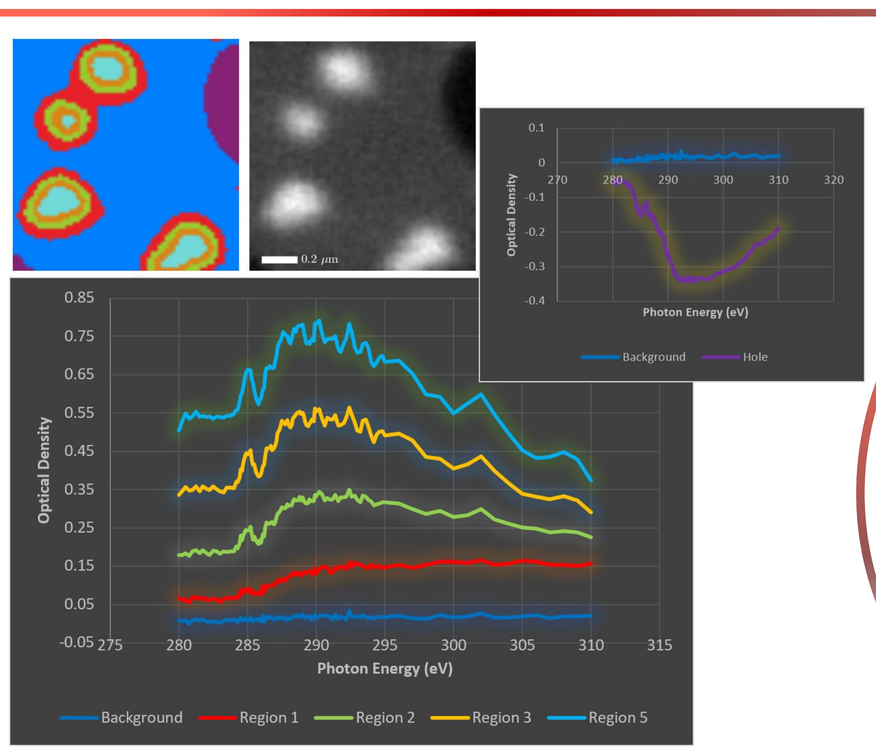


Fig 2. C K-edge from polydisperse laboratory generated sample.

## Results

- OD corrected sample images in monochrome.
- Spectral signatures from different sample regions in corresponding colours.
- Background in blue.

Lab generated sample

Plastic samples

Urban aerosol samples

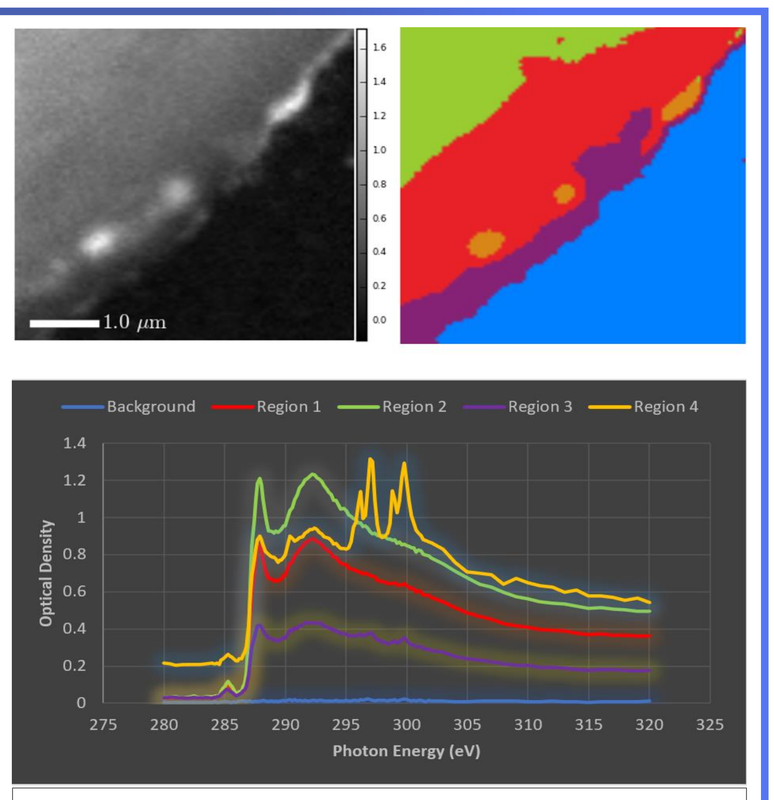


Fig 3. C K-edge from 60 nm polyethylene slice.

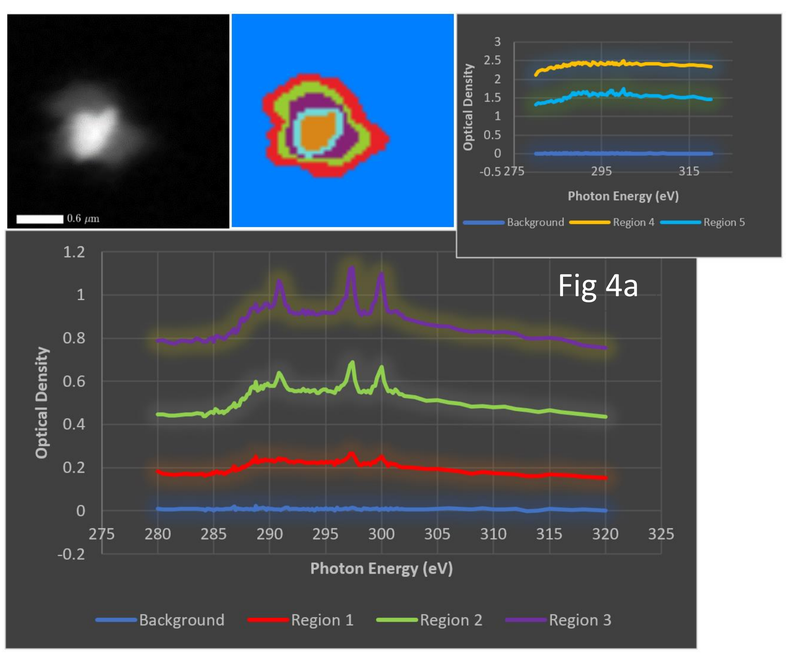


Fig 4a

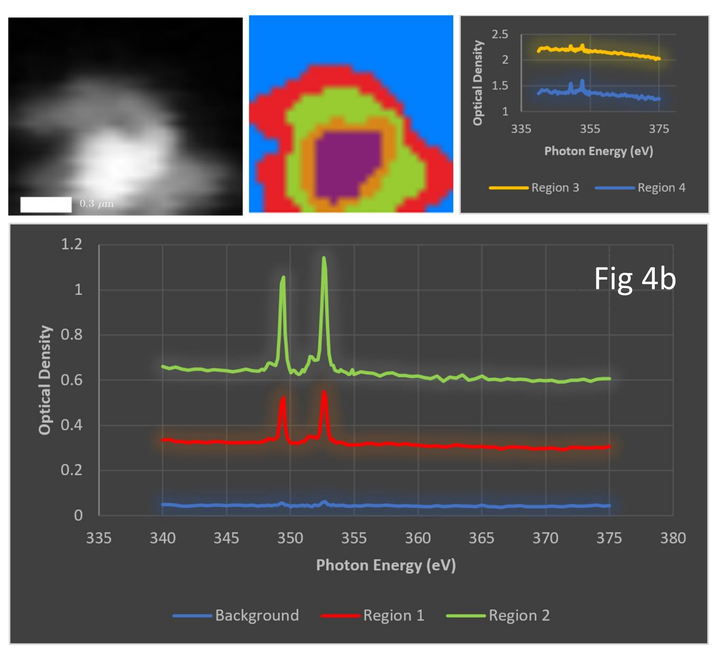


Fig 4b

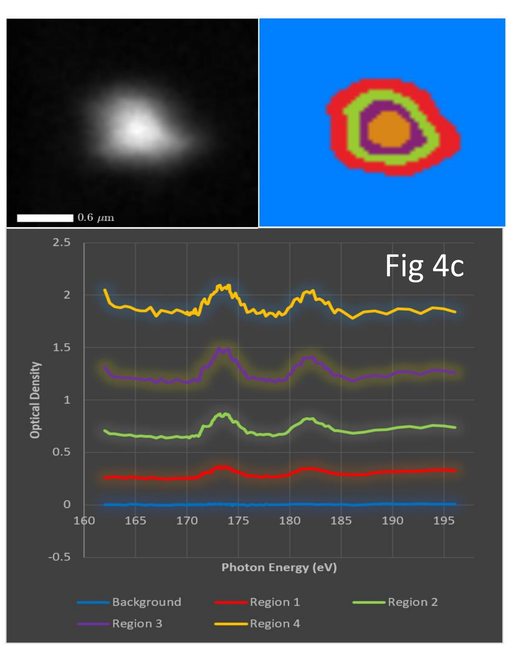


Fig 4c

Fig 4. C K-edge (Fig 4a), Ca L-edge (Fig 4b), and S L-edge (4c) from the same single urban aerosol particle.

## Conclusions

- Demonstrates the viability of using STXM to obtain structural information and spatial distribution of individual molecular components of atmospherically relevant particles.
- Showed formation of specific structures in lab generated samples.
- Obtained reference for STXM studies on microplastics and shows impurities in the preparation polyethylene preparation.
- Shows presence of multiple chemical components in a single urban aerosol particle.

## References

1. IPCC, 2021: Climate Change 2021: The Physical Science Basis. doi:10.1017/9781009157896
2. Solaris National Synchrotron Radiation Centre. *STXM - SOLARIS National Synchrotron Radiation Centre - Jagiellonian University*, https://synchrotron.uj.edu.pl/en_GB/linie-badawcze/demeter/STXM. .

## @ MAX IV

Possibilty to study atmospherically relevant aerosol particles through similar experiments at **SoftiMAX**.

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