

# Microstructural changes on the carbon functional groups of individual aerosol particles from cooking activities during photochemical oxidation

E. Coz<sup>1</sup>, I. El Haddad<sup>2</sup>, S. Platt<sup>2</sup>, J. G. Slowik<sup>2</sup>, A. S. H. Prévôt<sup>2</sup>, S. Steimer<sup>3,4</sup>, G. Grzanic<sup>3,5</sup>, M. Lampimäki<sup>3</sup>, B. Artiñano<sup>1</sup> and M. Ammann<sup>3</sup>

<sup>1</sup>Department of the Environment, CIEMAT, Madrid, ES-28040, Spain

<sup>2</sup>Laboratory of Atmospheric Chemistry, PSI, Villigen-PSI, CH-5232, Switzerland

<sup>3</sup>Laboratory of Radiochemistry and Environmental Chemistry, PSI, Villigen-PSI, CH-5232, Switzerland

<sup>4</sup>IACETH, ETH Zurich, Zurich, CH-8092, Switzerland

<sup>5</sup>Department of Chemistry and Biochemistry, University of Bern, Bern, CH-3012, Switzerland

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Presenting author email: [esther.coz@ciemat.es](mailto:esther.coz@ciemat.es)

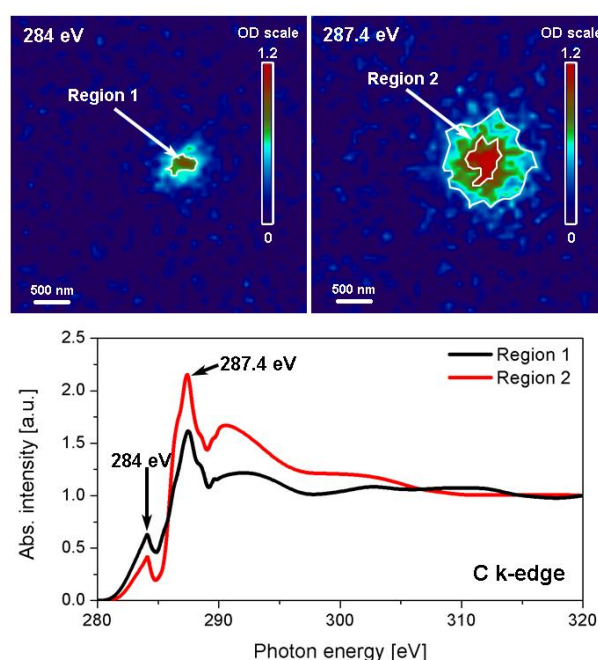
Cooking emissions are a major contributor to indoor and outdoor PM<sub>2.5</sub> organic aerosols (Mohr et al., 2012). Understanding the changes in behaviour and properties of these emissions with atmospheric processing is crucial to quantify their effects on climate and to design effective abatement strategies. Nevertheless, very little is known about the microstructural properties and the effects of atmospheric processing thereon, properties undoubtedly related with the optical and hygroscopic properties determinant on assessing the effects of aerosols on climate change.

The present study aimed at the characterization of the chemical heterogeneities and changes in the internal microstructure of individual aerosol particles from different cooking activities. The major goal was to establish a relation between changes in the carbon functional groups and photochemical aging in laboratory generated aerosol particles, not only identifying the different groups but the spatial distribution within the individual particle structure.

The aging experiments were conducted in the PSI mobile smog chamber (Platt et al., 2012) with grilled chicken/NO<sub>x</sub>/hv and boiled vegetables/NO<sub>x</sub>/hv, as testing systems for the cooking emissions. Two different samples were collected during the experiment timeline, from primary and aged emissions, to be subsequently analyzed by STXM/NEXAFS at the Pollux beamline of the PSI SLS (Raabe et al., 2008). Complementary high-resolution SEM analyses were conducted to complete the microstructural study.

Results corroborated that cooking activities emit a variety of organic compounds that behave very differently during atmospheric processing from source to source and type of activity. This is also evidenced by changes in the particle structure. Vegetable boiling produced a wide range of primary organic structures not present when the emission is highly aged. These differences stressed the complexity in the interpretation of the results. In addition, no typical aged features were found on the NEXAFS spectra of the particles. In the case of the grilled meat, a major contribution of unsaturated moieties was found in particles from the slightly aged samples. The unsaturated groups seem to be the nuclei of the later condensed groups forming coatings of different thicknesses (Fig. 1). This was consistent with the results from the AMS analysis. This novel information is especially interesting for the

improvement of the radiative transfer and CCN (Cloud Condensation Nuclei) activity estimations that include a core-to-shell particle model in climate change studies.



**Figure 1.** Top: Optical density (O.D.) images of a particle from the meat-cooking sample measured at 284.0 eV (quinone-C) and 287.4 eV (aromatic/aliphatic-C) (Hopkins et al., 2007). Bottom: C K-edge spectra of the regions 1 and 2 from the same particle.

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