Topographic confocal Raman microscopy. Established methods – Novel concepts – New possibilities

J. TOPORSKI AND T. DIEING

(jan.toporski@witec.de, thomas.dieing@witec.de)

Confocal Raman microscopy has found increasing relevance over the past years in various field of application in geo- and/or geobiology research. The benefit of obtaining molecular, compositional information on the submicron-scale in three dimensions is of tremendous use yet thus far slightly alleviated by that "large" topography in the range of hundreds of micron or millimeters could not be analyzed without sample pretreatment, i.e. cutting or polishing to obtain a sufficiently flat surface. The new technique of Topographic Confocal Raman Imaging now allows analysis of rough surfaces or tilted samples.

The core element of this imaging mode is an integrated sensor for optical profilometry. Large-area topographic coordinates from the profilometer measurement are correlated with the large-area confocal Raman imaging data. This allows confocal Raman imaging along inclined or rough samples with the true surface held in constant focus while maintaining high level of confocality. The profilometry capabilities of True Surface Imaging mode allows scan ranges of up to 50x100 mm with a spatial resolution on the order of 100 nm vertically and 10 μm laterally. Measuring distances of 10 mm and more provide flexibility for variable sample size requirements. In combination with AFM, the profilometer can even be used as a pre-inspection tool to determine topographic features of interest for high-resolution AFM investigations on large samples.

The potential and examples for Geoscience applications will be shown.

Revisiting the influence of particle size on the equilibrium composition

D. TOPPING[1,2]* AND G. MCFIGGANS[1]

[1]Centre for Atmospheric Science, University of Manchester, UK (*correspondence: david.topping@manchester.ac.uk)

[2]National Centre for Atmospheric Science, University of Manchester, UK

Introduction

Atmospheric aerosol particles can comprise many thousands of largely unidentified compounds with a wide range of properties. The size of an aerosol particle influences the equilibrium composition and phase state for a given set of ambient conditions and availability of semi-volatile material. Incorporating the influence of curvature in theoretical constructs can be complex. Unfortunately, basic absorptive equilibrium partitioning models largely neglect the influence of curvature, leading to errors in predicted composition and volatility for conditions in which size is likely to play an important role: new particle formation in the atmosphere or unseeded experiments in smog chambers.

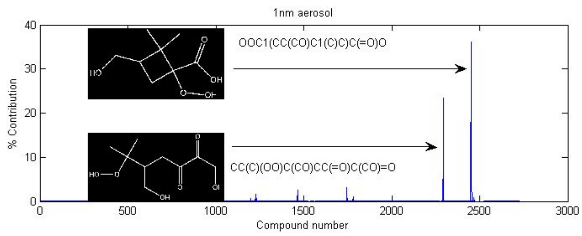

Figure 1: Example of identification of top two compounds contributing to the condensed phase abundance for a 2nm diameter aerosol.

Discussion of Results

In this study we present application of a partitioning model that explicitly accounts for impact of curvature on the equilibrium position for particles of any size and comprised of an unlimited number of compounds. Using results from state-of-the-art gas phase degradation models and property predictive techniques, we are able to explore generalised relationships between, for example, expected aerosol functionality and particle size (e.g. Figure 1). A discussion of the caveats behind this approach is given, along with pitfalls of not explictly accounting for aerosol size in previously applied predictive frameworks with potential impacts of subsequent aerosol properties.