On-line measurement of reactive oxygen species (ROS) in ambient air

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In this study, we use an on-line reactive oxygen species (ROS) analyzer to detect and compare ROS in the particle phase of ambient aerosol in different urban areas. Bern (Switzerland) and Beijing (China) were chosen to assess the effects of ambient particles especially ROS on human health.

We developed this method further according to King et al. and Fuller et al. with a time resolution of a few minutes [1, 2]. ROS are measured based on the fluorescent detection of dichlorofluorescein (DCF). In presence of horseradish peroxidase 2',7'-dichlorofluorescin (DCFH) is oxidized to fluorescent DCF and subsequently detected using a fluorimeter. The detection limit was estimated to be ~1.2 nmol m^{-3}.

Our first ambient measurements were performed at the Institute of Anatomy at the University of Bern during winter time. At the same time cell exposure experiments using fully differentiated human bronchial epithelia were performed. Particle mass concentrations of particulate matter smaller than 2.5 μm ($PM_{2.5}$) were quite low and as the ROS content of $PM_{2.5}$ in ambient particles was below the detection limit, the versatile aerosol concentration enrichment system (VACES) [3] was employed during ROS measurement. Using the VACES the concentration of $PM_{2.5}$ could be enriched by up to a factor of 25 and a diurnal variation of ROS could be recorded. Additional measurements including a scanning mobility particle sizer (SMPS), a condensation particle counter (CPC), an aerosol chemical speciation monitor (ACSM) and an aethalometer gave additional information on the size and chemical composition of $PM_{2.5}$.

In collaboration with the Institute of Earth Environment, Chinese Academy of Sciences, we participated in field measurement campaigns in Beijing. We were able to measure ROS directly in ambient particles during haze days.

The ROS contents of Bern and Beijing will be presented, giving a deeper insight in the diurnal variation of ROS and the behavior during haze events in Beijing.

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