EGU22-8206, updated on 13 Aug 2022
https://doi.org/10.5194/egusphere-egu22-8206
EGU General Assembly 2022

Oxidative Potential of Transition Metals and Secondary Organic Aerosols using an Online Oxidative Potential Ascorbic Acid Instrument (OOPAAI) to Quantify Aerosol Toxicity

Battist Utinger, Steven John Campbell, Alexandre Barth, Benjamin Gfeller, Nicolas Bukowiecki, and Markus Kalberer
University of Basel, Basel, Switzerland (battist.utinger@unibas.ch)

Regardless of decades of convincing epidemiological evidence, large uncertainty remains regarding the physical and chemical characteristics of aerosols, as well as the toxicity mechanisms upon exposure to human health.
Oxidative potential (OP) is defined as the capability of particles to catalytically produce reactive oxygen species (ROS) with subsequent depletion of anti-oxidants, naturally present in the human lung. OP has been widely suggested as a measure of the potential toxicity of aerosols, but suitable instruments, especially for continuous field deployment are lacking. Due to the circumstance that ROS (i.e. inorganic and organic peroxides and radicals) are highly reactive, they are therefore short-lived. Thus, classical offline analysis, where aerosol particles are typically collected on a filter for 24h or longer prior to analysis, may lead to an underestimation of the oxidative potential.
Therefore, we developed an online instrument that can continuously measure particle oxidative potential with immediately sampling of particles, and a high time resolution (10 minutes). We further developed an online instrument described in Wragg *et al.* (2016) and implemented a physiologically relevant assay to assess aerosol oxidative potential, based on the chemistry of ascorbic acid (Campbell *et al.* (2019)). Ascorbic acid (AA) is a prevalent naturally occurring anti-oxidant present in the lung and can therefore be used as a proxy to measure the oxidative potential and thus toxicity of aerosol particles.
In this work, we present the overall design and operation of the OOPAAI (Campbell et al., 2019, Anal. Chem.). Recent improvements are also discussed where we further developed the OOPAAI into a field-deployable instrument with an improved continuous flow cell for fluorescence detection, a particle to liquid sampler with a higher efficiency and optimizations of the chemical reaction system to ensure that the ascorbic acid assay is stable and buffered at pH 6.8. These technical developments of the OOPAAI improved its detection limit, operational stability and physiological relevance.
A range of laboratory flow tube studies were conducted to identify the OP of secondary organic aerosols (SOA) from naphthalene and beta-pinene and metal particles (Fe and Cu). A range of synergistic and antagonistic effects was observed when the OP of mixtures of metal and SOA particles was quantified.
With the improvements of having a more physiological relevant assay and an improved detection

method, this instrument is capable of providing a real time and more realistic estimation of the oxidising aerosol properties and their potential effect on human health. Moreover, in lab-based experiments the OOPAAI helps to gain better understanding of fundamental interaction between different aerosol types like organic aerosols and transition metals and their influence on OP and hence their potential toxicity.

Wragg, F. P. H. *et al.* (2016), *Atmospheric Measurement Techniques*, 9(10), pp. 4891–4900.

Campbell, S. J. *et al.* (2019), *Analytical Chemistry*, 91, 20, 13088-13095.