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Towards continuous measurement of the oxidative potential of the air

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Whereas PM mass concentration is associated in epidemiological studies to health effects, this indicator may underestimate the overall impact, as often a large amount of low-toxicity compounds contribute to the mass. On the contrary, the presence of tiny amount of toxic or redox active chemical on the surface of PM are not taken into account by such a metric. The measure of oxidative properties - that is the OP - of ambient aerosol appears as a more integrative metric than mass to evaluate their health effect. In contrast to off-line OP measurement approaches based on PM sampling on filters [1], we developed an integrated OP determination device that relies on photonic transducer able to perform on-line OP analysis of the full aerosol: gas and particle phases. The developed OP determination device was deployed at an urban air quality station in the city of Lausanne (Switzerland), to perform measurements during multiple weeks jointly to standard environmental pollutants monitoring such as NOx, ozone, $PM_{2.5}$ and ultrafine particles.

The on-line measurement system is based on a configuration in which i) the air sample is sprayed into clean water as sample collecting medium (flow rate: 2 $Lmin^{-1}$) in order to maximize the air-liquid interface; ii) the water-transferred sample is driven through a series of actuators to the sensing chamber where a reactive solution containing Fe(II) is added; iii) the kinetics of Fe(II) oxidation is followed with photonic measurements using orange LED (580 nm) as probing light, NIR LED as reference (950 nm) and CMOS photodetector as a transducer. Reservoirs for water, reactive and waste enable the OP device to run autonomously for one week without intervention. For on-site measurements the OP device was set in an air quality station located at the vicinity of a construction site and vehicle traffic.

The analytical performances of the photonic detection core as well as the fully automated instrumentation gives rise to a short time-resolution of about 8 min and limit-of-detection below 10 pmol (eq. H_2O_2). The preliminary results obtained from a measurement campaign conducted in winter 2023 at the air quality station clearly indicate that O_3 strongly contributes to the OP, notably more than $PM_{2.5}$. The possibility to perform continuous and long-term OP measurements along with the monitoring of standard air pollutants as well as meteorological conditions will definitively help in refining our understanding of this emerging metric.

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[1] P.A. Dominutti, P.A. et al. *Environ. Sci.: Atmos.* **2023**, *3*, 1497-1512.