NEW STRATEGIES FOR NON-INVASIVE PH SENSING OF AEROSOLS

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ABSTRACT

Atmospheric particulate matter impacts almost every aspect of the Earth system and society. It affects climate & precipitation and upon inhalation can lead to premature mortality and sickness. Transport and deposition of aerosol can also strongly impact ecosystems, and highly toxic compounds contained within particles can affect water quality and soils. Much of these impacts strongly depend on the acidity levels in the particles.[1] Aerosol particle pH is a parameter of central importance owing to its driving impact on atmospheric chemistry. pH modulates the amount of particulate matter that can be formed, as well as the chemical composition of aerosol particles which means it can affect the multitude of impacts of particles on public health, ecosystems and climate. Despite its importance, pH cannot be directly sensed in atmospheric particles because of their extremely small size and rapid response to perturbations in their immediate environment.

In this study a non-invasive strategy of the pH monitoring of the aerosols is proposed. It is based on the deposition of aerosol nano/microparticles on functionalized pH-sensitive filter surfaces whose response is monitored *via* Raman/SERS measurements. A redox-active pH responsive polymeric substrate either infiltrated within the porous of a (non-woven quartz) filter or as stand-alone film is used to act as sensing material for the quantification of aerosols acidity levels (as well as of other environmental contaminants) that deposit on the filter during normal sampling operation. The polymeric model system under investigation is the polybenzimidazole (PBI).[2] Upon exposure to acids/bases, PBI is protonated/deprotonated, with structural variations that exhibit distinct Raman fingerprints activity. In addition to the polymeric PBI, other low molecular weight pH responsive molecules are also examined as surface modifiers of plasmonic nanostructures. Their structural alterations caused by pH could be traced even at low concentrations through surface enhanced Raman scattering (SERS) phenomenon. The monitoring of the Raman/SERS spectral variations after aerosol exposure is expected to reflect the changes in the degree of protonation/deprotonation of the polymer induced by the deposited aerosol, and associated acidity. Different ways of film preparation may affect the pH sensitivity; relevant approaches examined until now are: (i) film casting, (ii) phase inversion membrane and (iii) electrospun (nano)fibers. Their efficacy is tested using standard pH controlled aerosols.

KEYWORDS: Aerosols sensing, Raman Spectroscopy, pH responsive, atmospheric pollution

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