IDENTIFICATION AND CHARACTERIZATION OF AIRBORNE NANOMATERIALS IN MULTIPLE EXPOSURE WORKPLACE SCENARIOS

The assessment of occupational exposure to airborne nanomaterials is based on a multi-parameter approach that considers not only the contribution of airborne sub-micrometric particulate matter—such as particle mass concentration (PMC), particle number concentration (PNC), particle size distribution (PSD), and lung-deposited surface area (LDSA)—but also includes different atmospheric pollutants generated during production or originated from external sources, both anthropogenic and natural. Indeed, multi-exposure is a critical factor in determining both short- and long-term health effects on workers and should also be considered a potential pathway for gaseous pollutants, which may be transported through adsorption onto airborne particles.

Furthermore, it is essential to distinguish between emissions originating from background sources and those directly related to production processes. The simultaneous presence of atmospheric pollutants can lead to the formation of particulate matter through nucleation, Aitken mode, or accumulation processes, resulting in Secondary Organic Aerosols (SOA) and Secondary Inorganic Aerosols (SIA). The particle sizes of these aerosols often overlap and interfere with the emissions relevant to occupational exposure assessments, as they fall within the size range of ultrafine particles (UFPs).

Typical sources of secondary particulate matter include sulphur compounds (e.g., SO_2, H_2S), nitrogen compounds (e.g., NO, NO_2, NH_3), and carbon compounds (e.g., hydrocarbons, CO). Through various chemical and physicochemical reactions, these compounds can form nitrates (NO_3^-) from NO_2, sulphates (SO_4^{2-}) from SO_2, and organic particles from volatile organic compounds (VOCs). One of the main sources of SOA is the gas-phase oxidation of VOCs by atmospheric ozone (O_3).

It is crucial to have a clear understanding of the working environment in order to identify all potential sources of emissions that define exposure. This allows for the selection of the most appropriate parameters to accurately quantify exposure levels and characterize the physicochemical properties of nanomaterials (NMs) collected from the workplace air.