The Need of Novel Particle Composition Metrics to explain the link between Aerosol Particle Composition and Cellular Toxicity Pathways

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Atmospheric aerosol particles are known to have severe negative health effect, increasing a very wide range of diseases and contributing to over 6 million death per year worldwide. The particle components responsible for these toxic effects are not known, mainly due to the highly complex and dynamic composition of particles. Oxidising particle components such as peroxides and radicals could potentially explain or contribute to the observed particle toxicity. A wide range of analysis methods have been developed over the last decade to estimate the overall oxidative properties of particles. Due to the often highly reactive nature and therefore short lifetime of many of these compounds, fast analysis techniques are required to quantify oxidising particle properties. We developed a novel field-deployable instrument to quantify also very short-lived oxidising particle components. Laboratory and field studies demonstrate that a huge fraction (70% to over 95%) of oxidising particle components has a lifetime of only a few minutes. This short-lived nature of oxidising particle components makes is very challenging to relate this metric with health effects when quantified from filter samples where aerosol particles are usually stored over days to months before analysis. These differences are also observed when particles are deposited on human lung cell cultures directly out of a continuous air flow compared to particles that have been collected on filters before deposition on cells, indicating that the effect of short-lived oxidising particle components also translates to cellular pathways relevant to immune response and oxidative stress in the lung.