Air-liquid interface exposure system for in vitro toxicological studies of wood combustion aerosols

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Background:

Exposure to ambient aerosols can epidemiologically be linked to increased morbidity and mortality rates, while aerosols formed during combustion processes seem to be the most potent hazards [1]. Current attempts to replace fossil fuels by regenerative sources create new additional sources for emissions of combustion derived aerosols. Despite of their high impact on human health, combustion aerosols, especially from regenerative sources, are insufficiently characterized. The aerosol components responsible for the adverse effects as well as the underlying mechanisms are yet to be identified. Addressing this knowledge gap, the "Helmholtz Virtual Institute of Complex Molecular Systems in Environmental Health" (HICE) conducts joint measurement campaigns wherein controlled aerosol generation by combustion of different fossil fuels (e.g. wood, diesel) is combined with comprehensive on-line characterization of the aerosols and in vitro investigations of their effects on human cells.

Material and Methods:

Most in vitro studies on aerosol health effects rely on submerged exposure of collected particulate matter, suspended in the medium. This method alters many characteristics of the aerosol. In contrast, the use of an air-liquid interface (ALI) exposure system allows on-line exposure experiments during aerosol generation while maintaining most of the physical and chemical characteristics of the aerosol components. Additionally, the possibility to separate the particulate phase from the whole aerosol is an important tool to study the relevance of gaseous components. For the reproducible assessment of lung toxicity of airborne particle emissions from combustion processes the Karlsruhe Exposure System was developed as described in detail before [2]. To cope with the high number of samples including controls needed for the biological characterization during the HICE measurement campaigns, a new ALI exposure system with up to 18 sampling positions has been built. As an option, electrostatic deposition can be used to increase the particle dose on the cells per time unit.

Figure 1. HICE exposure system for air-liquid interface exposure of human lung cells towards combustion derived particle emissions

Preliminary results of wood smoke exposed A549 human lung epithelial cells show no cytotoxicity but an induction of xenobiotic-metabolizing enzymes, attributable to the particulate matter.

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References:

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