Air-liquid interface exposure systems for the assessment of toxicity of combustion aerosols

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Despite numerous efforts to reduce the ambient air concentrations of fine particles by improved combustion and filter technologies, the health effects due to inhalation of ultrafine particles are still the most important problem in environmental health. Besides the combustion of fossil fuels the increasing combustion of wood in domestic stoves and boilers may even increase the fine particle burden.

The on-line characterization of physico-chemical properties of combustion derived particles has progressed by application of novel particle sizers and mass spectrometry. The assessment of health effects is still conducted by epidemiology or costly animal experiments. Characterization of biological effects of ultrafine particles to human cells by in-vitro studies, with particle extracts induces numerous artifacts during sampling, extraction, dose determination and biological testing, all of which renders the results derived hardly reproducible. The application of air-liquid interface exposure of human lungs cells to characterize the biological effects of combustion aerosols will avoid many of the pitfalls of the previous method [1].

Experimental

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]. In this fully automatic system cell cultures (A549, BEAS-2B) grown on porous membrane inserts, which are in contact with nutrient medium, are exposed directly to diluted aerosol from combustion sources.

To reduce sampling and filter artefacts the system is interfaced to the off gas duct by means of a porous tube diluter. The aerosol passes through the size selective inlet to exclude the particles size fraction above 2.5 µm. In the conditioning reactor the gas is humidified by steam injection. By metallic sampling probes the gas samples are drawn into the air-liquid interface modules (Vitrocell systems) by a vacuum pump. For each of the 18 exposure positions the flow rate is measured by a mass flow controller. All exposure parameters such as temperatures and flow rates are recorded by a Lab View data acquisition system.

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

To estimate the deposited particles mass calibration experiments with fluorescent nanoparticles are conducted prior to the exposure.

First results from the exposure of A549 human lung epithelial cells will be reported.

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References:

[1] Paur, H.-R., Cassee, F. R., Teeguarden, J., Fissan, H., Diabate, S., Aufderheide, M., Kreyling, W. G., et al. (2011). *Journal of Aerosol Science*, 42(10), 668–692. doi:10.1016/j.jaerosci.2011.06.005

[2] Paur, H.R., Mülhopt, S., Diabaté, S., Weiss, C. (2008) *Journal für Verbraucherschutz und Lebensmittelsicherheit*, 3, 319-329