Experimental investigation of the transport and deposition of ambient aerosols in the human airways

A. Nagy, A. Kerekes, A. Czitrovszky

Institute for Solid State Physics and Optics, Wigner Research Centre for Physics of the H.A.S,
Budapest 1121, Hungary

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Presenting author email: nagy.attila@wigner.mta.hu

Contamination of the atmosphere especially in large cities and in many workplaces leads to growing risks to human health - smog alerts and excess of the limits are more frequently occur. The most common diseases that lead to the most work loss are respiratory diseases - allergic respiratory symptoms are now considered endemic. There is a growing number of asthma and COPD.

The investigation of the transport and deposition of inhaled aerosols in human airways is a rather difficult task with "in vivo" methods. The various imaging techniques are capable of formulating certain statements regarding the respiratory deposition of particles, but in many cases their application raises ethical issues due to the required radiation dose, their resolution is not sufficient and the equipments are expensive. These reasons provided the driving force of "in vitro" studies and the development of various simulation techniques.

The aim of this study is the experimental investigation of the transport and deposition of ambient detrimental or toxic aerosols in human airways with contact- and perturbation-free laser optical measurement methods. These investigations provide essential information on detrimental health effects of ambient aerosols, which depends on the spatial distribution of the deposition. (Salma et al. 2002, Balásházy et al. 2003)

The experimental research was carried out using laser light scattering measurement techniques (particle counting, laser Doppler velocimetry) and Raman-luminescence-spectroscopy. Hollow realistic lung models were produced by 3D rapid prototyping technique in 1:1 size and geometry based on CT image series of human airways. Breathing was forced by a programmable and controllable breathing simulator, specially developed for this research. (Kerekes et al. 2009, 2012)

Laboratory tests were carried out with the developed complex measuring system using generated well defined particles and compared the results with computer simulations based on numerical CFD codes.

After the laboratory tests experimental data were obtained by the system using in-door air.

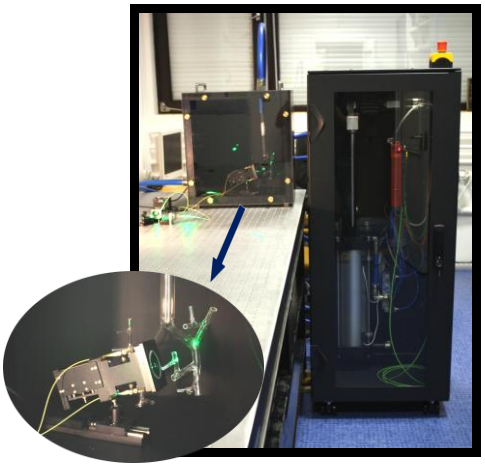

Figure 1. Experimental setup.

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