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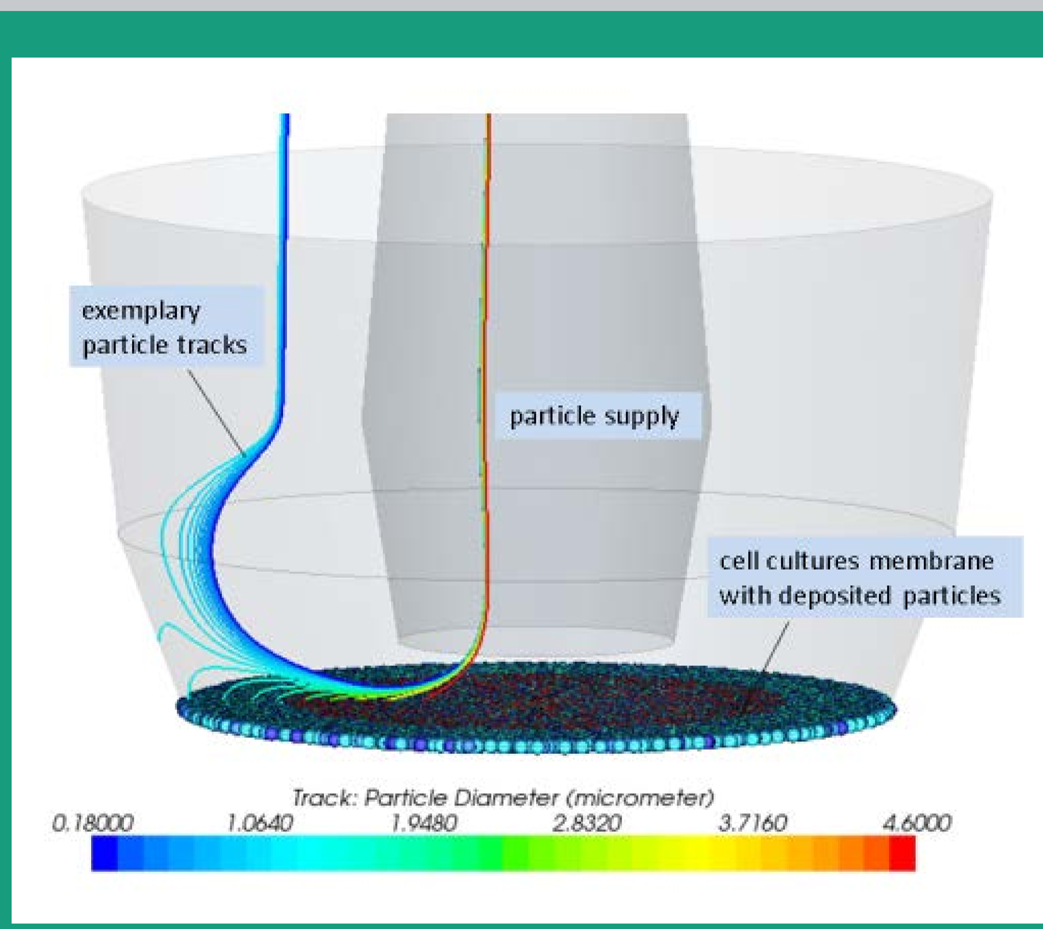

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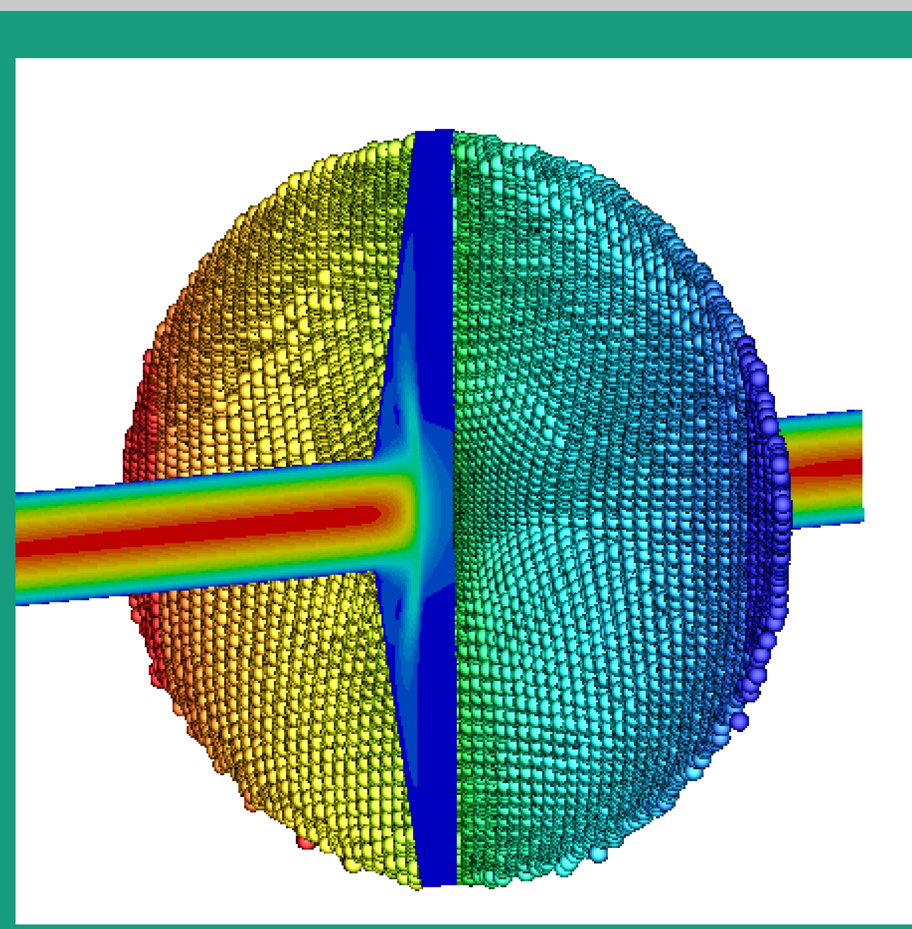

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P.R.I.T.® PROFESSIONAL IN-VITRO TECHNOLOGIES by Fraunhofer ITEM

INFLUENCE OF THE GEOMETRY OF AN AEROSOL CONDUCTING SYSTEM ON THE DEPOSITION OF PARTICLES FROM INHALABLE AEROSOLS ON CELLULAR SURFACES IN-VITRO

Background

The air- liquid interphase (ALI) cell culture technology is the state-of-the-art method for in-vitro testing of airborne substances. Cells are cultured on the apical side of microporous membranes and thereby get efficiently into contact with the test atmosphere using an exposure device (Fig. 1). For the application of this basic technology on the testing of a broader range of airborne materials like droplet and particle aerosols, there is still no general scientific consensus on the question of the most suitable exposure design. The deposition rate achieved by sedimentation and diffusion mechanisms is usually in the range of 1% to 2% for inhalable particle sizes between 100 and 1000 nm using such exposure systems. Concepts including electrostatic deposition of particles or thermophoresis have been introduced to increase the deposition to address specific scientific questions.

Objective

A concept for a more general application of the ALI culture technology for all kinds of airborne materials with optimized particle deposition rates has to be developed. Commonly, stagnation flow ALI systems are used and this study aimed at the characterization of the influence of shape and geometry of the inlet as an important component of the flow aerosol conduction system on the particle deposition.

CFD Simulation

In the CFD simulation models (Fig. 2, 3, 4) applied within the scope of this project the fluid air is treated as an incompressible continuum in an Euler frame of reference and as a laminar flow. The aerosol particles are regarded as solid spheres of different size in a Lagrangian frame of reference. The particles exhibit inertia and are exposed to drag, pressure and gravity forces. Additionally Brownian diffusion was accounted for, especially for submicron particles. Deposition behaviour of particle sizes in the range between 5 and 3000 nm were investigated.

Results

The deposition of particles on the cell membrane (Fig.3) was simulated. Particle transport mechanisms were clarified. Deposition rate is rather insensitive to geometry (Fig. 4).

Results (cont'd)

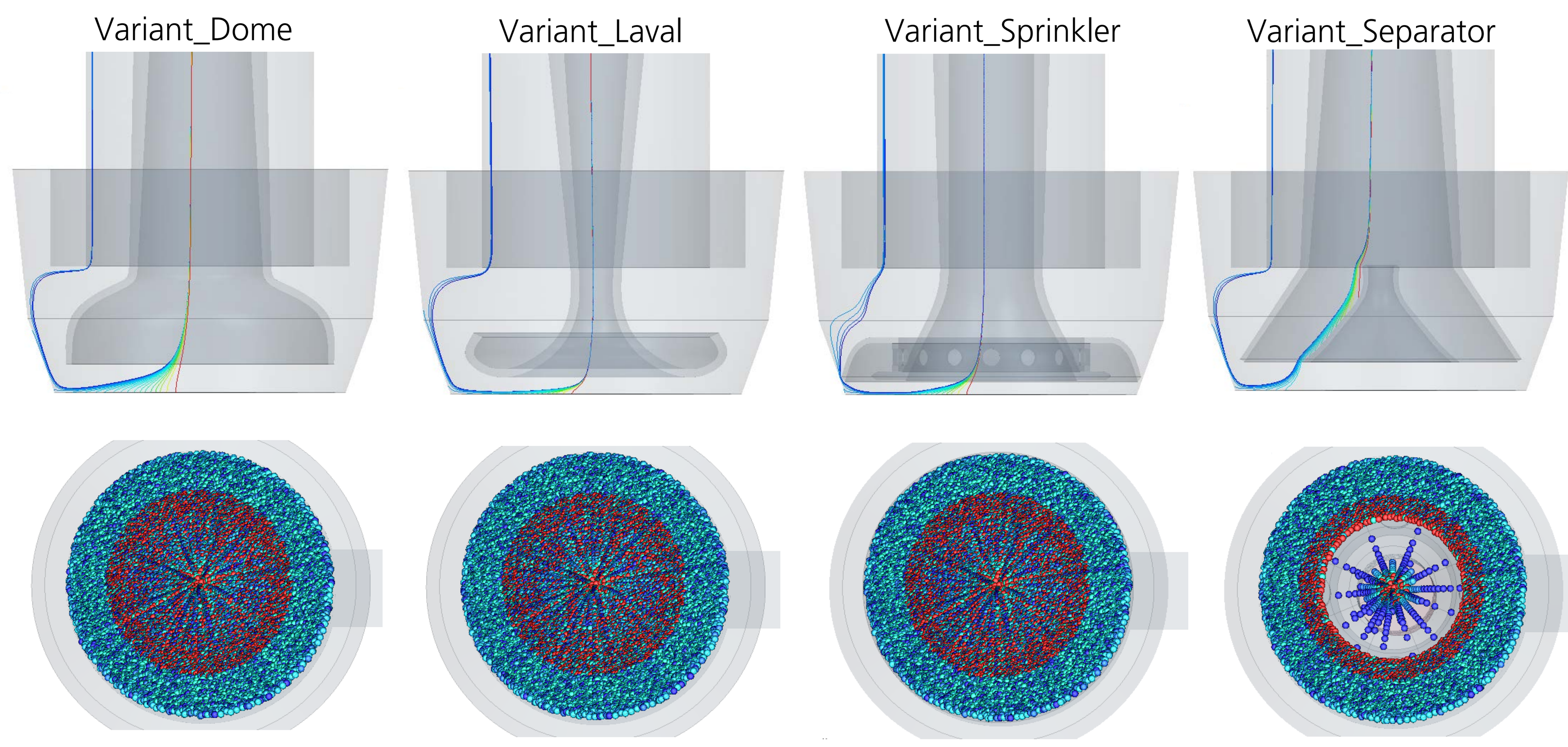
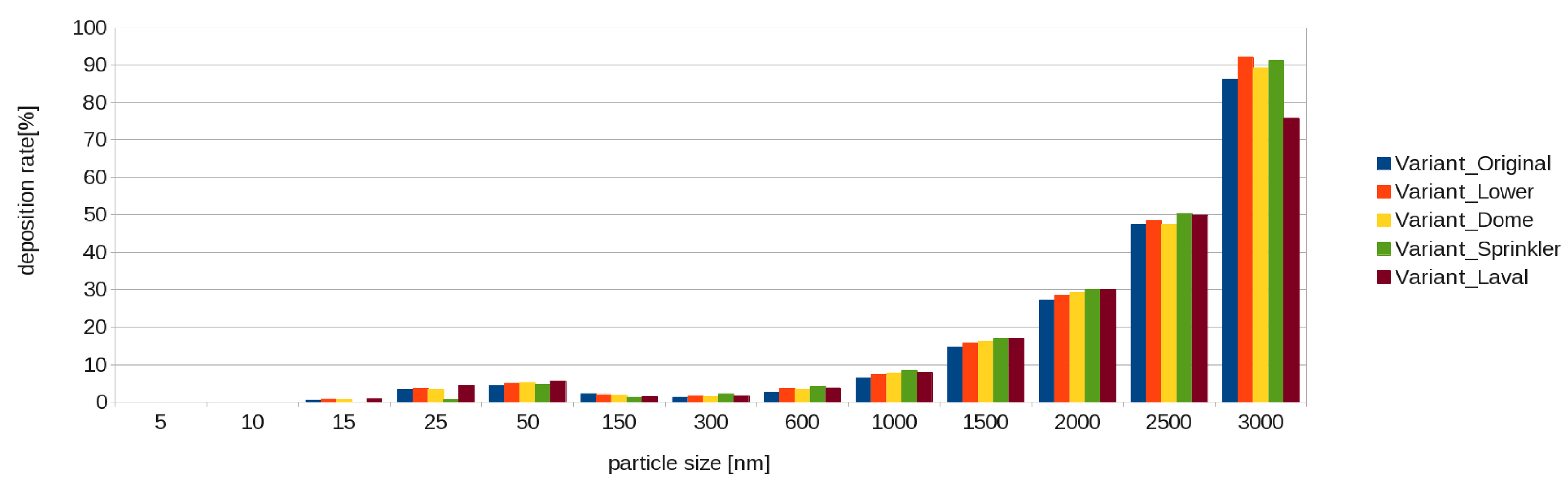


Fig. 4: Particle tracks and deposition of particles with different diameters for selected examples



Tab.1: Deposition rate vs. particle size for selected examples

Conclusion

- Despite the extreme variation of the inlet nozzles, the deposition rate was rather unaffected for most geometries.
- Particle distribution on the membrane depends on particle size (Fig. 4) but was similar for most geometries, two variants were differing.

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