The goal of this research is to develop a more powerful exposure assessment tool that estimates lung deposition of inhaled particles to the human lung. A device that estimates lung deposition of inhaled particles will improve the power of risk assessment by providing a more physiologically-relevant measure of dose, and hence, inhalation hazard. We developed a model to predict particle penetration through porous foam media as a function of foam characteristics, particle size, and airflow. Our semi-empirical model builds upon the work of Vincent et al. and Kenny et al., and utilizes three particle collection mechanisms: diffusion, inertia, and gravity. Four foam types of differing thickness and porosity were tested, along with solid and liquid particles ranging in size from 0.02 to 1 μm. Application of the model indicates that a foam sampler may be developed with collection efficiency that approximates the ICRP lung-deposition curve.

Penetration-based samplers (inhalable, thoracic, respirable) account for particle intake, but not deposition. Exhaled aerosol does not contribute to dose, and the degree of exhaled aerosol depends strongly on the particle size distribution. A sampler that measures only deposition will better estimate dose, and hence, risk.

Using a solver function within Excel, we have inverted the model with appropriate constraints to design a foam with deposition characteristics that mimic the ICRP lung deposition curve. Future work will evaluate the deposition characteristics of the proposed sampler in laboratory and field settings. We hope to design a second generation of deposition samplers calibrated to match regional deposition efficiencies of the nasal-pharyngeal, bronchial, and respiratory regions of the lung.