Development of a Novel Los Cost Sampler to Estimate Aerosal Deposition within the Human Lung

Epidemiological studies that seek to associate reduced human health with exposure to occupational and environmental aerosols are often hampered by limitations in the exposure assessment process. Ideally, an exposure assessment would contain repeated measurements on a personal level for many individuals over a period of a time that is commensurate with the hypothesized development of disease. In many cases, hundreds (if not thousands) of individuals must be studied to achieve sufficient statistical confidence in the estimated risk ratio. Such ideals, however, are rarely achieved due to lack of personal exposure assessment methods that can be widely deployed at low cost. A second limitation involves the measured exposure metric itself. Current methods for personal exposure assessment are designed to estimate the intake of aerosol to the respiratory system. Since a large proportion of inhaled aerosol is subsequently exhaled, a portion of intake will not contribute to the dose of the individual. This leads to variable exposure misclassification (for heterogeneous exposures) and increased uncertainty in health effect associations. Additionally, at this time, the methods used to estimate personal aerosol exposure are expensive, typically costing 4500 or more per unit. As such, personal exposure assessment for a large study population is cost-prohibitive.

To address these challenges, we propose to develop a sampling method to estimate the respiratory deposition of aerosols on a personal level. Furthermore, we expect that our system will cost approximately one order of magnitude less than current methods, on a per-person basis. The proposed sampler uses polyurethane foam as the collection substrate. The foam has been engineered to have the same deposition efficiency, as a function of particle diameter, as a healthy human lung. The passage of air through this foam media has a low pressure drop, unlike standard filter media. Consequently, we believe that the flow through the sampler can be accommodated with a simple computer cooling fan, yielding a sampling system which is small, lightweight, inexpensive, and can operate on a 9 volt battery.

This device will provide a more biologically relevant estimate of aerosol does at a greatly reduced unit price, allowing large scale epidemiologic studies to be completed at reduced cost. We believe that this sampling unit has the potential to revolutionize the state-of-the-science in air pollution exposure assessment.