Washington University in St. Louis
School of Engineering & Applied Science

Energy, Environmental & Chemical Engineering

EECE Department Seminar

Friday, November 3, 2017

11:00am

Brauer Hall, Room 12

A super-efficient sampler for viable virus aerosols using water-based condensation particle growth

ABSTRACT

Respiratory and other infectious diseases can be acquired through inhalation of airborne virus particles. Effectively sampling nanometer-sized virus particles has been a challenge, since existing bioaerosol samplers were designed to collect particles larger than about 0.5 µm and therefore collect viral aerosols (20 - 100 nm) with very low efficiency (5 – 10%). A new sampling method using laminar-flow, water-based condensation growth significantly improves the physical collection efficiency and maintains the viability of the captured viruses. Inside the sampler, supersaturated water vapor condenses on aerosol particles as small as 5 nm to create a fog of droplets of 2-5 µm in size, which are then easily collected by gentle, low-velocity impingement into a liquid medium.

In this study, the performance of a Viable Virus Aerosol Sampler (VIVAS) was evaluated using aerosolized MS2 bacteriophage (28 nm dia.) and H1N1 influenza virus (IFV; 80-120 nm dia.) The physical collection efficiency was > 90% for the VIVAS, as compared to < 10% for the industry standard, the BioSampler, for an order of magnitude improvement. The fraction of MS2 particles that remained viable after capture averaged 45 times greater for the VIVAS, when using water as the collection medium. MS2 recovery in the VIVAS was enhanced to more than 100 times greater than the BioSampler with tryptone yeast extract broth as the collection medium. Collection of the infectious IFV particles was 74% with the VIVAS, which was 13 times higher than the BioSampler (5.6%). The true capture recovery may be higher as transport losses or inactivation from the aerosolization process were not taken into account. These tests show that the water-based condensation technology provides a powerful tool for more accurate assessment of infectious airborne virus transmission and health threats than the existing bioaerosol samplers can offer.

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Professor Chang-Yu Wu received his BS from Mechanical Engineering Department at National Taiwan University and PhD from the Department of Civil & Environmental Engineering at the University of Cincinnati. His teaching and research interests range from air pollution control, aerosol science, environmental nanotechnology, dust control to engineering education. He has published more than 140 refereed journal particles and given 280+ conference presentations and 70+ invited lectures. His research has resulted in 6 US patents and 3 pending applications. An active member of Air & Waste Management Association and American Association for Aerosol research, he has received several awards recognizing his accomplishments in education, research and service.

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