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Ultrafine Particles from Ozone and Personal Care Products

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Supported by:

Funded by:
NATIONAL RESEARCH FOUNDATION

Summary

Exposure to ultrafine particles (UFP) is linked to cardiopulmonary morbidity and mortality. Indoors, reactions between ozone and terpenes can trigger UFP production. Evidence suggests that some personal care products may contain chemicals that react rapidly with ozone to generate ultrafine particles. Such an emission source that is close to an individual's breathing zone can have amplified influence on inhalation exposures. This study aims to characterize UFP production owing to reactions of ozone with personal care products that are applied to the body.

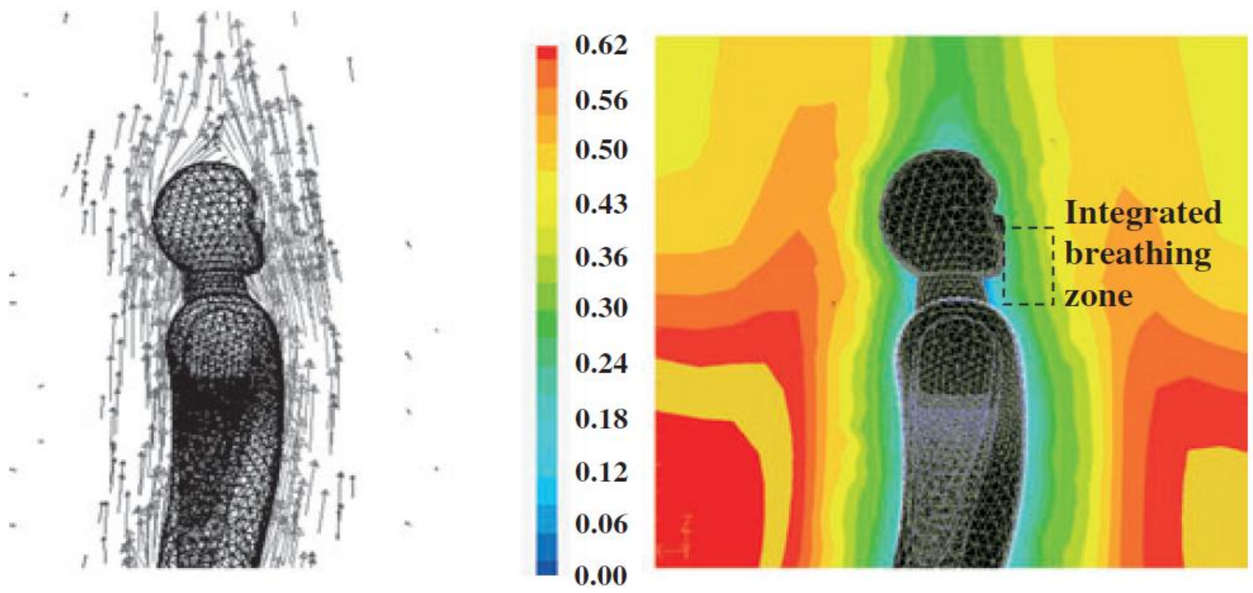
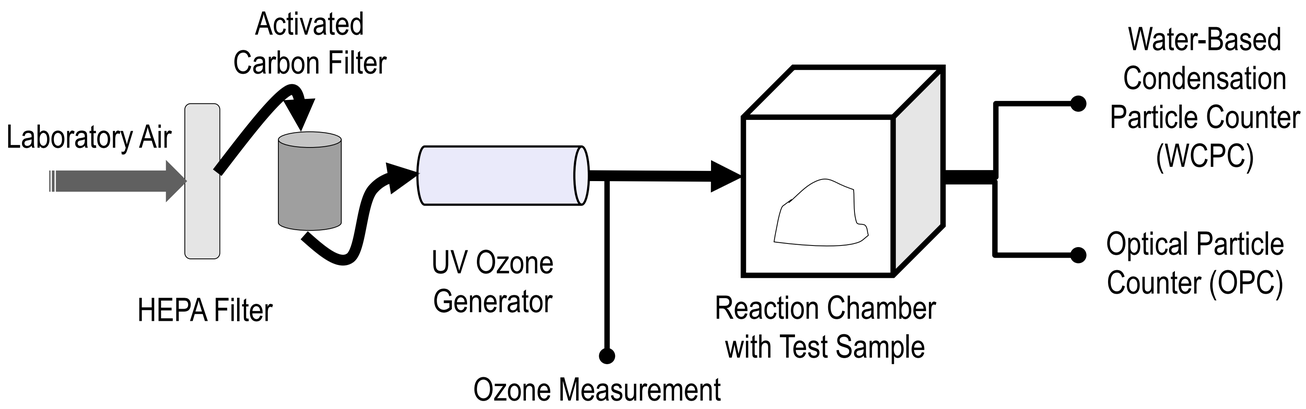


Figure 1. Thermal plume for a simulated occupant (left) and contour of ozone concentration relative to inlet concentration (right) [2]. These figures support a view that human-surface reaction products would be concentrated in a "cloud" around the body.

Experimental Apparatus



MSP Corp, model 1120 WCPC

Met One model GT-526 OPC

Continuing Work

Personal care products include precisely engineered (pharmaceuticals), biogenic ("natural"), highly volatile (fragrances), and chemically stable (crystalline make-up) products. This laboratory experiment is aimed at determining whether human-surface UFP production attributable to indoor ozone reactions with personal care products warrants further investigation by generating new data for many products sold in Singapore.

References

[1] RL Corsi, J Siegel, A Karamalegos, H Simon, GC Morrison, *Atmospheric Environment* **41**, 3161, 2007
[2] D Rim, A Novoselec, G Morrison, *Indoor Air* **19**, 324, 2009
[3] BK Coleman, MM Lunden, H Destaillats, WW Nazaroff, *Atmospheric Environment* **42**, 8234, 2008
[4] A Wisthaler and CJ Weschler, *Proceedings of the National Academy of Sciences* **107**, 6568, 2010

"Pigpen" Effect and Personal Reactive Clouds

Human exposure studies have revealed that breathing-zone concentrations of particulate matter are commonly higher than average concentrations in the spaces occupied. This phenomenon is known as the "personal cloud" or "pigpen effect."

The "personal reactive cloud" (PRC) concept extends this idea by suggesting that not only does proximity to sources increase exposure to primary emissions, but it can also increase exposures to secondary pollutants that are formed by reactive chemistry.

RL Corsi and colleagues first proposed the PRC idea [1]. They found that near head chemistry indeed occurred and concluded that "additional research is needed to characterize reaction products and health consequences associated with near-head chemistry and associated personal reactive clouds."

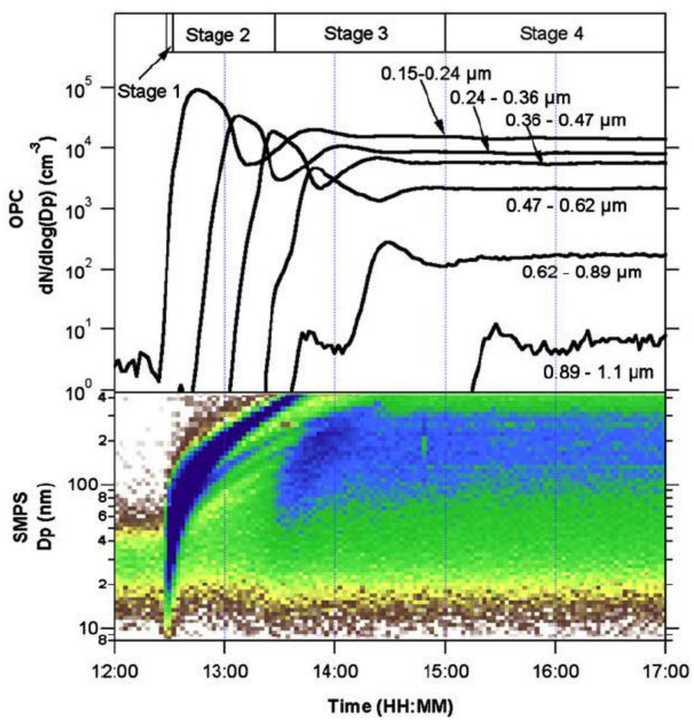


Figure 2.: Characteristic particle nucleation and growth caused by reactions of ozone with terpene-rich household cleaning products and air fresheners [3]

Many air fresheners use terpenes as scenting agents.

Ozone + Personal Care Products = Ultrafine Particles?

Indoor sources may be more important than outdoor pollution for human exposure to ultrafine particles (UFP). Common indoor UFP sources include objects that reach high temperatures, such as cooking equipment, and unvented combustion, such as candles. Ozone-initiated chemistry also produces UFP.

Only a few studies have investigated ozone interactions on skin surfaces and these have revealed significant reactive chemistry associated with personal care products [1] and with skin oil components such as squalene [4].

Implications

- ✓ Emissions that occur near the human surface cause disproportionately high exposures owing to increased breathing-zone concentrations.
- ✓ There is a need to understand UFP production from reactions involving personal care products