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UHealth UNIVERSITY OF MIAMI HEALTH SYSTEM | UNIVERSITY OF MIAMI MILLER SCHOOL of MEDICINE

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Responses of healthy & diseased airway epithelia to primary and photo-chemically aged aerosols from wood combustion

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Background and Aims

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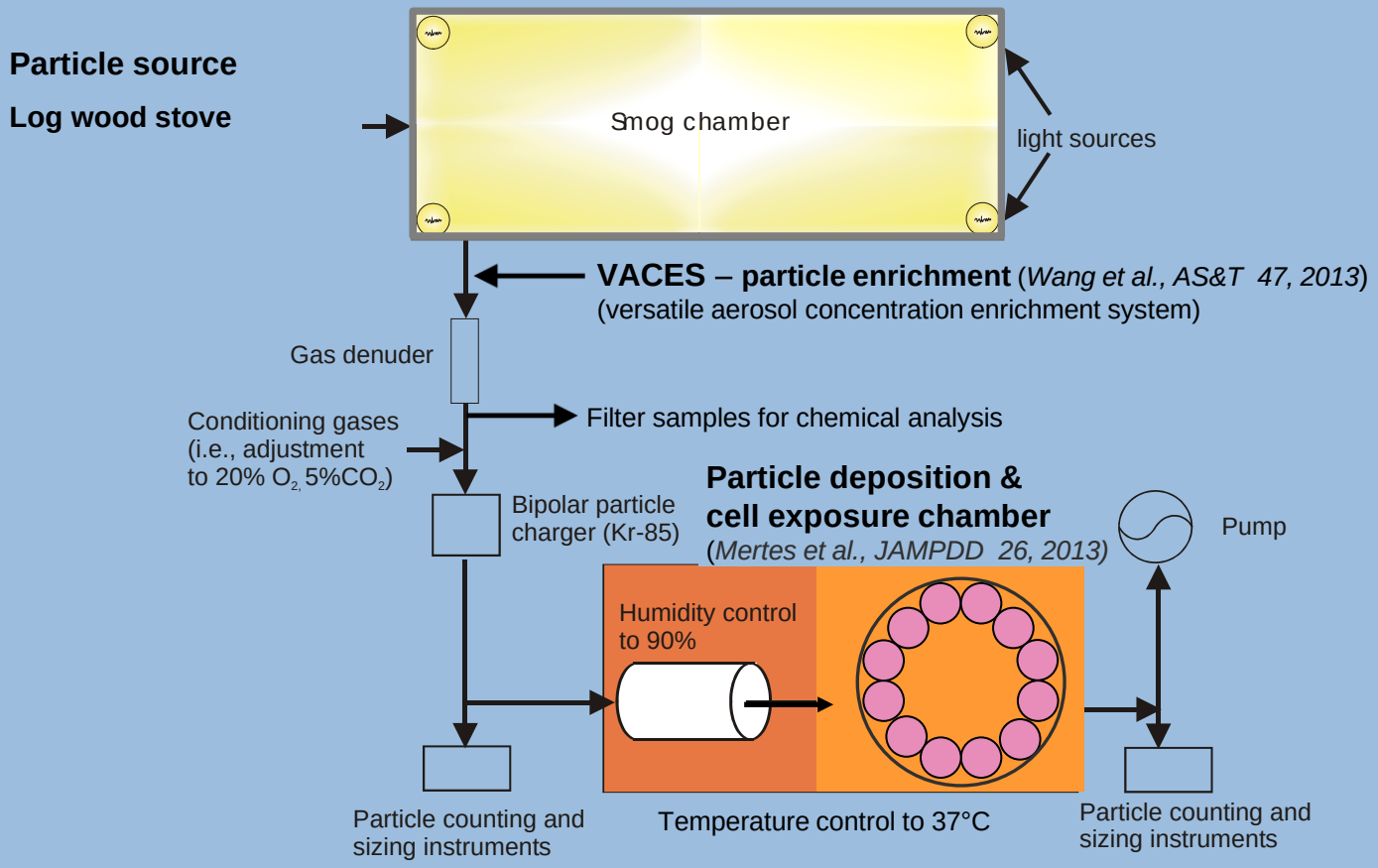
- Adverse health effects of inhaled fine and ultrafine particles
- Persons with pre-existing lung disease are more vulnerable

➔ Which particle characteristics induce the biological effects ?
➔ What biological parameters cause susceptibility ?

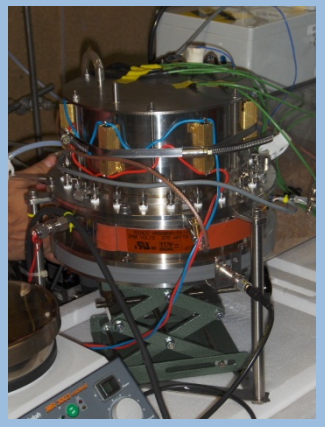
- Aerosols from wood combustion
- Effects due to different chemical composition but similar concentration of the particles
- In-vitro study simulating the situation in vivo

Experimental set-up

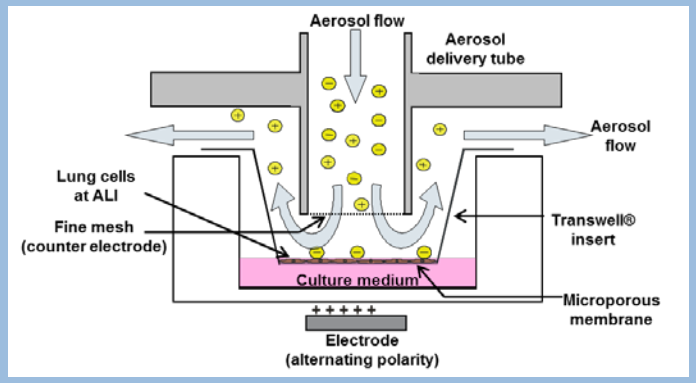


Methods
Particle deposition chamber

- Aerosol conditioning: 37°C, 85-95% RH
- Aerosol distribution: 12 delivery tubes
- Particle deposition: e-field: 4 kV/cm, alternating polarity: 1 Hz
- Total aerosol flow: 600 mL/min, 50 mL/min per tube
- Cell exposure: 12 cell cultures at air-liquid interface (ALI) on Transwell® inserts per plate



Particle deposition &
cell exposure chamber



Particle deposition by electrostatic precipitation

Cell culture models

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- Re-differentiated human bronchial epithelial cells
  - Respiratory epithelium with mucus secreting, ciliated & basal cells = pseudostratified epithelium
  - Tissue with low cell turnover
  - Production & maintenance of air-liquid interface = established ALI
  - Normal and diseased (cystic fibrosis, CF) donors

- Human bronchial epithelial cell line BEAS-2B
  - Monolayers of a single, cuboidal cell type
  - Immortalized, proliferating cells
  - Submersed cultures; reduced cell culture medium for exposure at ALI

Exposure protocol and cell analysis

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- Cell cultures on microporous filter inserts at ALI
- Single, short term (**2h**) exposure to aerosol
- Controls (untreated & **filtered-air** exposed)
- Cell analysis within **24h after exposure** (acute)
- Biological markers
  - Cytotoxicity (necrosis: release of lactate dehydrogenase, **LDH**)
  - Inflammatory mediator release (cytokines: **IL-6**, **IL-8**)

Results
Composition of exhaust & particle dose

- Medium and high stove load:
  - Organic compounds dominant
  - Black carbon depending on stove load
  - Constant particle dose (~ 270 ng/cm^2)

Results
Cellular responses

- Cytotoxicity
  - Increase of cytotoxicity after particle exposure in all cell models
  - BEAS-2B cells are more sensitive than re-differentiated cells
- IL-6 release
  - Increase in BEAS-2B cells only
- IL-8 release
  - Trend to increased IL-8 release in all cell models
  - Different baseline release of IL-8 in cell models
- Cause-effect relationship
  - Evidence for correlation of necrosis with distinct particle constituents

Conclusion

Evidence for adverse effects of primary and aged particles from wood combustion on airway epithelia:

(i) Increase of cytotoxicity after particle exposure

(ii) Correlation of cytotoxicity and specific particle components

(iii) Release of cytokines dependent on cell model

(iv) Different responses of epithelial cell line and differentiated epithelial cells