The effect of diluter configuration on characterization of flame-made particles

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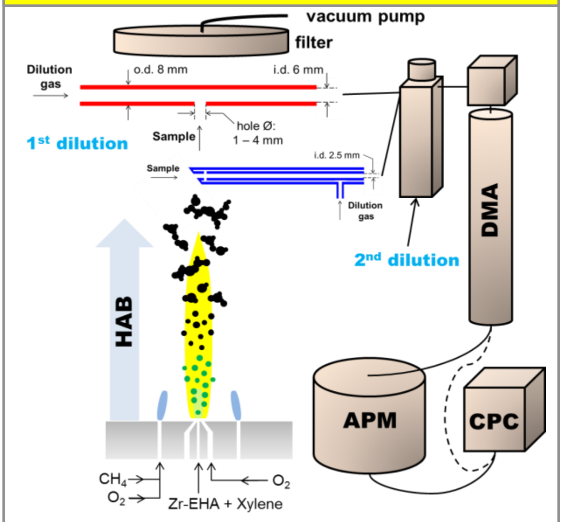
Motivation

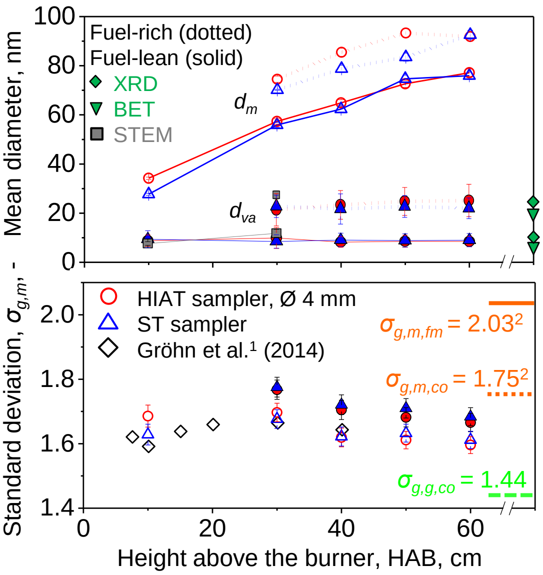
- Particle characteristics can change during sampling.
- The effect of diluter configuration on real-time characterization of flame-made ZrO_2 nanoparticles is investigated by mass-mobility size measurements and recently developed power laws for aggregates and agglomerates.
- The corresponding primary particle diameter is compared with off-line measurements (TEM, N_2 adsorption (BET) and XRD).

Method



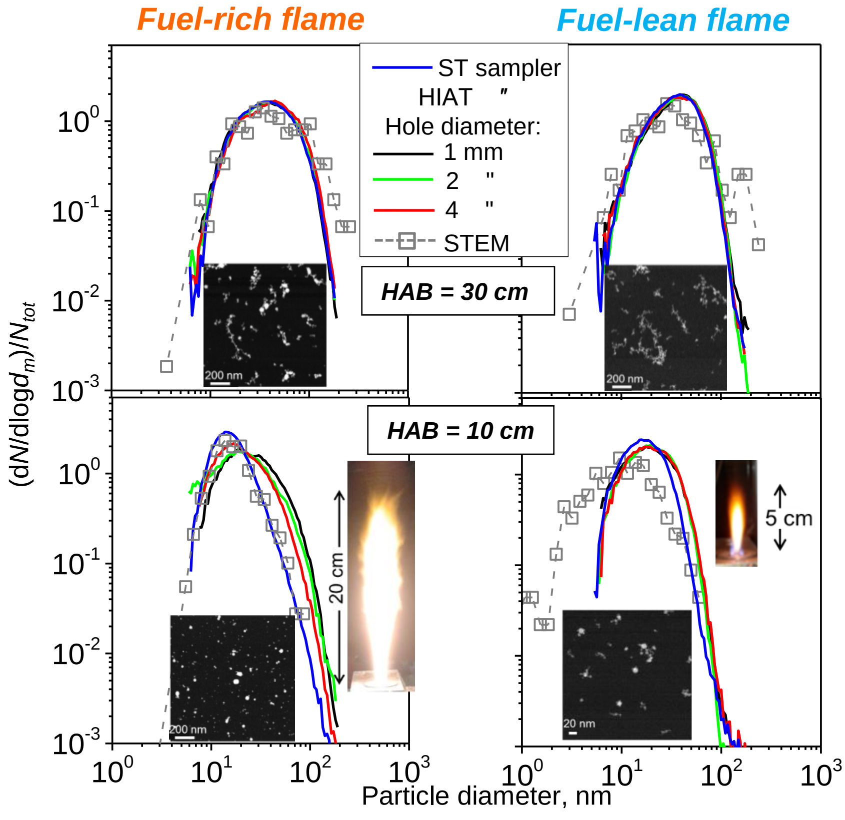
Schematic representation of the experimental set-up and sampling probe: HAB: height above the burner, DMA: differential mobility analyzer, APM: aerosol particle mass analyzer, CPC: condensation particle counter.

Particle characteristics



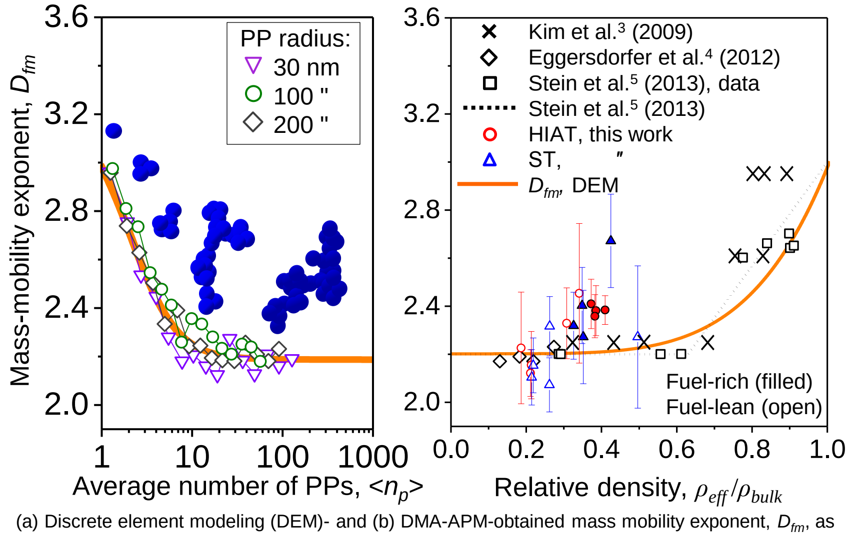
Sauter mean d_m and primary particle (PP) diameter, d_{va} (top), and geometric standard deviation of mobility diameter, $\sigma_{g,m}$ (bottom), at HAB = 10 – 60 cm for fuel-rich and -lean conditions.

Mobility size distributions



SMP size distributions of particles generated with fuel-rich and fuel-lean flame conditions sampled by a probe and three hole-in-a-tube diluters compared to TEM-obtained projected area equivalent size distributions accounting for diffusion losses.

Particle morphology (D_{fm})



(a) Discrete element modeling (DEM)- and (b) DMA-APM-obtained mass mobility exponent, D_{fm}, as function of the number of PPs per agglomerate, n_p, and particle relative density, ρ_{eff}/ρ_{bulk}.

Conclusions

1. Diluter configuration hardly affects the measured mobility size distribution of agglomerates for both flames except for the large tail at low HAB for the hot flame where gas-to-particle conversion might not have been completed.
2. The probe leads to smaller d_m than the 4 mm –hole-in-a-tube sampler due to faster mixing and quenching.
3. At high HAB all sampler configurations yield the same particle size distribution.
4. Particle morphology (D_{fm}) is related to the number of primary particles per agglomerate, n_p.

References

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