



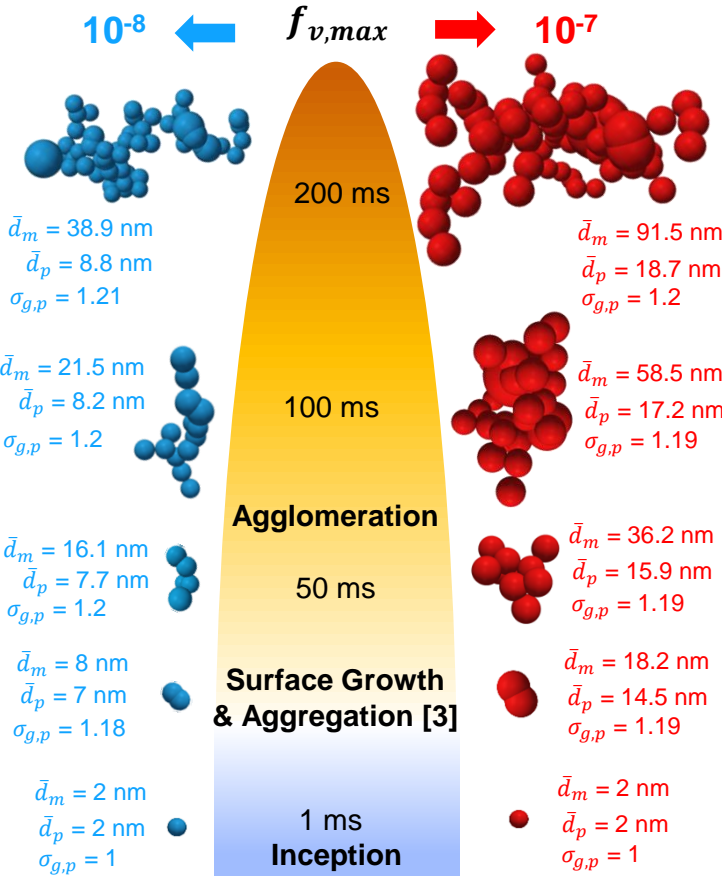
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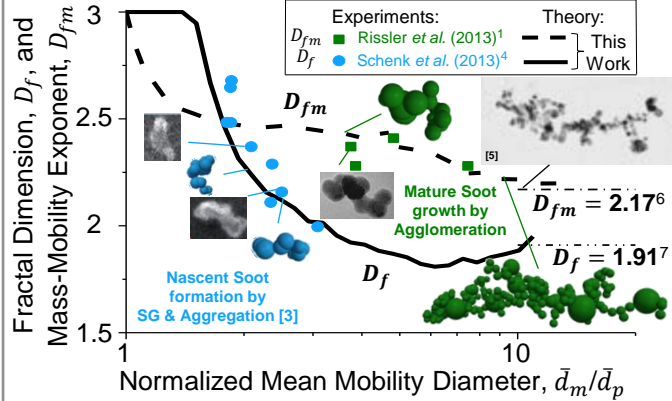
Motivation

Soot impact on health and environment strongly depends on its primary particle size, d_p , and effective density, ρ_{eff} .¹ Scaling laws based on clusters of primary particles in point contact (agglomerates) or chemically bonded (aggregates) have been used in tandem with mass-mobility measurements to obtain ρ_{eff} or d_p ,² respectively. Here, such relationships are derived by investigating soot aggregate dynamics with a Discrete Element Model (DEM) for agglomeration & surface growth.

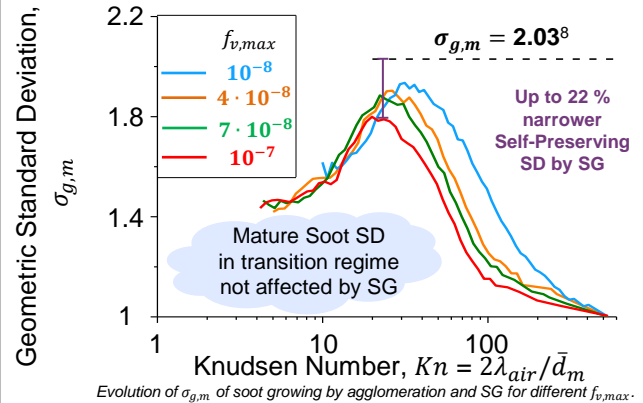
DEM-derived Evolution of Nascent to Mature Soot



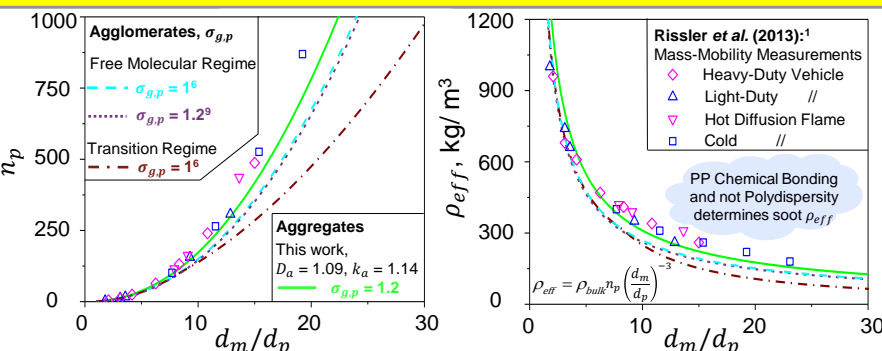
Morphology Dynamics of Nascent and Mature Soot



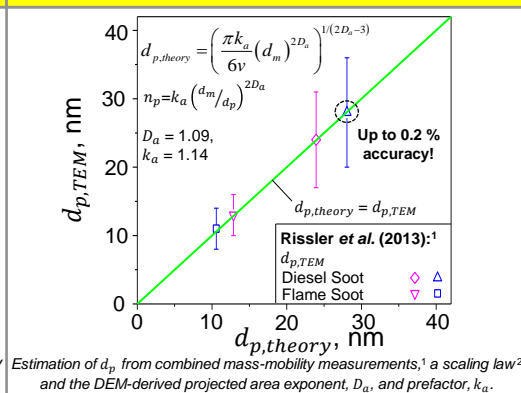
Dynamics of Soot Size Distribution (SD)



Mature Soot Structure and Effective Density



PP Diameter Estimation



References

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Conclusions

- Aggregation and SG form compact nascent and mature soot aggregates, while the asymptotic soot morphology is attained by their subsequent agglomeration.
- Good agreement between DEM and experimental data of nascent and mature soot structure was found.
- Surface Growth impact on nascent soot SD increases with higher $f_{v,max}$, narrowing the Self-Preserving SD in the free molecular regime up to 22%.
- Mature soot aggregates grow primarily by agglomeration in the transition regime, having identical $\sigma_{g,m}$ evolution for different $f_{v,max}$.
- The asymptotic D_a and k_a of mature soot accounting for the PP chemical bonding can be used in tandem with mass-mobility measurements to estimate accurately ρ_{eff} and d_p of aggregates from different combustion sources.