**Carbonaceous nanoparticle dynamics:**

**From global warming pollutants to functional nanomaterials**

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**Abstract**

Carbonaceous nanoparticles are ubiquitous, attracting the attention of various scientific fields. In particular, formation of carbonaceous aerosols by combustion is critical for the synthesis of functional nanomaterials, but also has high impact on public health and environment. For example, carbon black, the largest flame-made nanomaterial by value and volume (a $16 B industry), is a major component in tires, inks, batteries and solar cells. On the other hand, soot - a material very similar to carbon black - is an air pollutant whose contribution to global warming is currently estimated with large uncertainty. Here, the dynamics of carbonaceous nanoparticles are investigated both numerically and experimentally ([doi.org/10.1016/j.powtec. 2019.02.003](https://doi.org/10.1016/j.powtec.2019.02.003)) to advance our current understanding of particle formation during combustion. Discrete element modeling enables the detailed description of the particle morphology ([doi.org/10.1016/j.carbon.2017.06.004](https://www.sciencedirect.com/science/article/pii/S0008622317305717?via%3Dihub)) and optical properties ([doi.org/10.1016/j.proci.2018. 08.025](https://www.sciencedirect.com/science/article/pii/S1540748918305674?via%3Dihub)) in population balance models ([doi.org/10.1016/j.combustflame.2021.01.010](https://doi.org/10.1016/j.combustflame.2021.01.010)) and computational fluid dynamics. This facilitates the accurate estimation of the soot climate impact ([doi.org/10.1021/acs.est.2c00428](https://doi.org/10.1021/acs.est.2c00428)), the derivation of robust soot oxidation rates ([doi.org /10.1016/j.combustflame.2019.08.001](https://doi.org/10.1016/j.combustflame.2019.08.001)), as well as the design of novel, highly porous carbon black grades ([doi.org/10.1016/j.carbon.2022.06.020](https://doi.org/10.1016/j.carbon.2022.06.020)) for electrochemical energy storage.

**Bio**

Dr. Georgios Kelesidis is Lecturer and Research Associate at the Department of Mechanical and Process Engineering of ETH Zürich, Switzerland. He received a Diploma in Chemical Engineering from the University of Patras, Greece with honors (top 3%), along with the Limmat Stiftung Award of Academic Excellence (2013). His subsequent MSc studies in Process Engineering at ETH Zürich were supported by a Particle Technology Laboratory Fellowship (2013-2015), while his MSc thesis earned the IBM research prize (2017) for computer modelling and simulations in chemistry, biology and material science. His 2019 PhD thesis on the morphology and optical properties of flame-made nanoparticles received the 2020 PhD Award from GAeF (German Association for Aerosol Research) and the ETH medal for Outstanding Doctoral Thesis (top 8 %). He received also the 1st Graduate Student Award on Carbon Nanomaterials at the 2019 AIChE Annual Meeting (Orlando, FL, USA), as well as Best Poster Awards at the European Aerosol Conference (EAC) in 2016 (Tours, France) and 2020 (Aachen, Germany), the 2019 ETH Conference on Combustion Generated Nanoparticles (Zürich, Switzerland) and the 2019 Fall Meeting of the Material Research Society (MRS). The societal impact of his PhD research was also highlighted by the Forbes Magazine by including him in the 2020 Forbes 30 under 30 Europe list for Science & Healthcare. He has co-authored 20 peer-reviewed articles so far, being the first author in 15 of them. He has organized technical sessions at MRS (2016), EAC (2019-2021), the 2020 and 2021 Annual Meetings of the American Association for Aerosol Research and the 9th World Congress on Particle Technology (2022). He has supervised so far 7 MSc and 7 BSc students. He is currently supervising 1 PhD and 3 MSc students at ETH Zürich.