

The 25th KONA Award

Sotiris E. Pratsinis is professor of process engineering and materials science at the Swiss Federal Institute of Technology (ETH Zurich) since 1998. There he teaches Mass Transfer, Introduction to Nanoscale Engineering and Micro-Nano-Particle Technology. He received his Diploma in Chemical Engineering from Aristotle Univ. of Thessaloniki, Greece in 1977. He served in the Greek Navy and worked in a textile company before receiving his MSc (1982) and PhD from University of California, Los Angeles in 1985. He was in the faculty of the Univ. of Cincinnati, USA from 1985 to 2000. He has graduated 40 PhD students, now at leading positions in industry and academia, worldwide. He has published 400+ refereed journal articles and has been awarded 20+ patents that are licensed to industry and have contributed to the creation of four spinoffs.

His research focuses on *multiscale* particle dynamics & aerosol reactor design. He has pioneered flame synthesis of nanostructured materials with closely controlled characteristics. This scalable process is practiced today in industrial units and academic labs. For example, in April 2017 the German National Science Foundation launched a 6-year, 6M Euro program funding about 20 PhDs in German universities on the fundamentals of flame spray pyrolysis (FSP) that was developed in his laboratories back in 2002. Also Harvard's School of Public Health is using extensively his FSP for synthesis of nanomaterials of various sizes and compositions to benchmark their toxicity under \$5M funding by the U.S. National Institute of Health since 2016.

He first measured the oxidation rate of TiCl_4 for synthesis of TiO_2 that has been recognized as "... a landmark contribution to ... (pigment) industry...". He has led the development of innovative algorithms for agglomerate formation and growth by 2-dimensional (mass and surface area) population balances for reaction, coagulation and sintering. These models along with his proof of the rapid attainment of both *self-preserving* size distribution and *fractal-like* structure during aerosol synthesis of materials enabled him to create simple, reliable, unimodal and even monodisperse particle dynamics models. These are interfaced readily with fluid mechanics greatly facilitating process design for particle manufacture and processing. For example, his model for production of optical fiber pre-forms was the first of its kind and it is still used in industry.

Motivated by this quantitative understanding, he showed experimentally, how to control flame-made particle size, crystallinity and, for the first time, morphology: from perfectly spherical particles to highly ramified agglomerates. Most notably, he developed the above FSP process for synthesis of sophisticated particle compositions, up to 5 kg/h in his labs, perhaps world's largest such facility for manufacture of nanoparticles at an academic institution. With FSP he prepared novel heterogeneous catalysts (primarily for environmental remediation) and gas sensors (primarily for breath analysis) and, for the first time, flame-made nutritional supplements, dental and theranostic materials. Also his FSP contributed decisively to environmental policy by identifying the origins of nanosilver toxicity and even developing processes for "curing" it.

His program has been funded by both Swiss and U.S. National Science Foundations, European Union as well as by DuPont, Dow, Degussa, Toyota, Nestle, Siemens, Millennium, Bühler, Clariant & others. His research has been recognized by the 1988 *Kenneth T. Whitby Award* of the American Association of Aerosol Research, a 1989 *Presidential Young Investigator Award* from the U.S. National Science Foundation, a 1995 *Smoluchowski Award* by Gesellschaft für Aerosolforschung, the 2003 *Thomas Baron Award* by the American Institute of Chemical Engineers (AIChE). In 2009 he won an *Advanced Investigator Grant* from the European Research Council, in 2011 a *Humboldt Research Award* (Germany) and in 2018 both a *Fuchs Memorial Award* from the International Aerosol Research Assembly and the *Lifetime Achievement Award in Particle Technology* from AIChE. He is member of the *Swiss Academy of Engineering* since 2012.



Mr. Y. Hosokawa (Left), the president of Hosokawa Foundation and Prof. Pratsinis, the KONA Awardee