Wilhelm Jost Memorial Lecture

Chemical Kinetics in Multiphase Chemical Transformation

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Abstract:

Wilhelm Jost is particularly renowned for his contributions to the field of chemical kinetics and reaction dynamics. He has made significant advancements in understanding of how chemical reactions occur during combustion, which is critical for various applications ranging from industrial processes to energy production and environmental science. His work continues to support today's development of and transition to clean and energy-efficient chemical transformations.

Continuing and expanding of the foundational principles established by Wilhelm Jost, we have applied mass spectrometric approaches to provide basic insights into chemical kinetics of reaction networks of complex environments and applications. The first part of the talk focuses on new chemical insights into molecular-weight growth and soot formation chemistry in combustion processes by reactions of resonantly stabilized radicals. The second part of the talk focuses on reaction networks found in catalytic heterogeneous chemical transformations. Specifically, we will highlight new insights into gas-surface interactions during catalytic partial oxidation of methanol and oxidative coupling of methane with soft oxidants. The last part highlights how non-equilibrium plasma can initiate chemical conversion through the generation of charged species, radicals, and excited-state species. We will discuss examples from plasma-assisted chemical looping combustion and methane dry reforming.

Nils Hansen is a physical chemist at the Combustion Research Facility of the Sandia National Laboratories in Livermore, California, United States. He received his Ph.D. in Physical Chemistry under the supervision of Prof. F. Temps at the Christian-Albrechts-Universität Kiel, Germany (2000). Before joining Sandia in 2004, he worked with Prof. A. M. Wodtke as a postdoctoral researcher at UC Santa Barbara and as a staff member at the BASF AG, Ludwigshafen (Germany). Hansen's research focuses on gas-phase chemistry that is relevant for energy conversion processes. In his work, he unravels the fundamental chemistry of low-temperature oxidation and of aromatics formation in incomplete combustion processes, of gas-surface interactions in heterogeneous catalysis, and of plasma-assisted chemistry. He was elected a "Fellow of the Combustion Institute" in 2019 and a "Helmholtz International Fellow" in 2020.