Exploring Combustion Chemistry in Laboratory-Scale Model Flames: From Biofuels to Soot Formation

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Abstract

This presentation summarizes our recent experimental combustion chemistry studies that are focused on the understanding of the formation of aromatic species and their growth to polycyclic aromatic hydrocarbons (PAHs) and soot. In our experiments, premixed and non-premixed flames are analyzed by flame-sampling molecular-beam time-of-flight mass spectrometry employing photoionization by tunable vacuum-ultraviolet synchrotron radiation. Isomer-resolving photoionization efficiency curves and detailed modeling results reveal the influence of different fuel structures on the formation of aromatic compounds and their commonly considered precursors. Furthermore, the chemical composition of soot nanoparticles is investigated using aerosol mass spectrometry, which yields a comprehensive picture of the chemical composition of the sampled particles. The second part of the talk is concerned with the combustion chemistry of oxygenated, alternative fuels, specifically alcohols. Detailed kinetic modeling and quantitative mole fraction profiles of species from within *n*- and *iso*-butanol flames are combined to investigate the combustion of these next generation biofuels.

Biography

Dr. Nils Hansen was graduated from Christian-Albrechts-Universität Kiel, Germany in 2000. He was a postdoc at University of California at Santa Barbara from 2001 to 2003 and was a staff scientist at the BASF AG, Ludwigshafen, Germany from 2003 to 2004. Since joining Sandia's Combustion Research Facility in 2004 as the principal investigator in the "Flame Chemistry and Diagnostics Laboratory", his research is devoted towards a molecular-level understanding of combustion chemistry. Employing both laser diagnostics and mass spectrometry, the combustion chemistry of premixed and non-premixed hydrocarbons and/or oxygenated biofuels is being investigated with an unprecedented level of detail. He is also the leader "ALS flame team", which is working on the synchrotron-based flame diagnosis. He is the winner of the Feodor-Lynen-Fellowship of the Alexander von Humboldt-Foundation, Alumni-Award of the Alexander von Humboldt-Foundation and Sandia National Laboratories Recognition Awards for a) "Sustained Excellence" an b) "Outstanding Performance in Flame Research". He has authored more than 50 journal papers in Science, Combustion and Flame, Proceedings of the Combustion Institute, etc..

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