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Advances and Challenges in Experimental Research of Combustion

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Over the last decade the Chemical Dynamics Beamline at the Advanced Light Source (ALS) of the Lawrence Berkeley National Laboratory has been used extensively to provide unprecedentedly detailed insights into the chemical structure of flames. The isomer-resolved, quantitative data has been used world-wide to update and improve chemical kinetic models for the combustion of hydrocarbon fuels and for prototypical biofuels, i.e. alcohols, ethers, and esters. This presentation summarizes some of the recent findings, for which synchrotron radiation and its properties had been essential.
In the second part of the talk, I will highlight the new combustion experiments at the ALS, which are targeted towards gaining a deeper understanding of the formation of aromatic species and their growth to soot particles in combustion environments and towards unravelling details of the low-temperature combustion chemistry. To this end, we have installed diffusion flames and jet-stirred reactors and also utilize flame-sampling aerosol mass spectrometry. Some early highlights, e.g. limitations of the so-called HACA growth mechanism and the detection of ketohydroperoxides, will be presented.
The experimental work which will be presented is done in collaboration with the groups of Kohse-Höinghaus (Bielefeld), Kasper (Duisburg-Essen), Sarathy (KAUST), Yang (Tsinghua), Michelsen (Sandia), Dagaut (Orleans), Taatjes (Sandia), Leone (Berkeley), and Yu (Princeton).

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