UF-CRDS: A PULSED UNIFORM FLOW APPARATUS WITH CW-CAVITY-RINGDOWN SPECTROSCOPY

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We introduce a new apparatus in which a high-performance pulsed supersonic uniform flow from a Laval nozzle is coupled with a continuous wave cavity ringdown spectroscopy (cw-CRDS). This approach is related to the CRESU[a] technique developed in France to study reaction kinetics at low temperature. A related system developed in our group in which chirped-pulse microwave spectroscopy is coupled to a pulsed Laval flow has successfully demonstrated its investigative capability of isomer-specific product branching in reactions and photodissociation at temperatures as low as 22 K[b]. The pulsed uniform flow is produced by means of a high throughput piezoelectric stack valve combined with a Laval nozzle.[c] At present, we employ two machined aluminum nozzles (for carrier gases He and Ar at temperatures around 25 K), and numerous in-house 3D printed nozzles. The 3D printed nozzles are designed using a Matlab program developed in-house, which allows us to create supersonic uniforms flows with different carrier gases at various temperature and densities. These nozzles are validated experimentally as well as theoretically using a computational fluid dynamics program, OpenFOAM.

The current configuration can probe the pulsed uniform flow either by cw-CRDS, operated in the near infrared region, or laser-induced fluorescence as in the traditional CRESU approach. The cw-CRDS spectrometer consists of a high finesse optical cavity (F 200000) which is composed of two high reflective plano-concave mirrors (R 99.9988%) leading to an empty cavity decay constant of 160 μs. We adopt a modified version of the timing strategy which was reported by Hippler M. et al[d] in order to probe reactants of bimolecular reactions formed from photolysis. We will present our first low temperature kinetics experiments performed with this apparatus including reaction of CN (v=1) with alkenes probed by cw-CRDS.

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