# Experimental Investigation of the Influence of Inert Gas on Soot Formation

Alexandre Flügel[1,2], Sebastian Beer[1], Stefan Will[1], Johannes Kiefer[2,3] and Alfred Leipertz[1,2]

*[1]Lehrstuhl für Technische Thermodynamik (LTT), Universität Erlangen-Nürnberg, Am Weichselgarten 8, D-91058 Erlangen, Germany*
*[2]Erlangen Graduate School in Advanced Optical Technologies (SAOT), Paul-Gordan-Str. 6, D-91052 Erlangen, Germany*
*[3]School of Engineering, University of Aberdeen, Fraser Nobel Building, King's College, Aberdeen AB24 3UE, Scotland, UK*

*(**Alexandre Dias Flügel, alexandre.d.fluegel@ltt.uni-erlangen.de**)*

The formation of soot in non-premixed flames is influenced by many parameters, and the detailed mechanisms are yet to be fully understood. Adding inert gas to the fuel supply of a burner has an inhibitory effect on soot formation. This reduction in soot inception is probably caused by the reduction of the flame temperature and hindered air entrainment due to a modified diffusion.

In this work, laser-induced incandescence (LII) was employed in laminar propane diffusion flames at atmospheric pressure in order to study the influence of adding inert gas on soot concentration and primary particle size. A co-axial burner stabilized with an air co-flow was used to produce a stable propane flame with constant propane mass flow. The burner has a inner diameter of 13 mm, the inner diameter of the co-flow was 89 mm, resulting in $Re_{fuel}$=52 (for undiluted conditions) and $Re_{air}$ = 102, respectively. The fuel was diluted with nitrogen, carbon dioxide and argon. The mass flow rate of propane was kept constant at 4.3 mg/s and the inert gas was varied from 0 to 5 mg/s in steps of 0.5 mg/s at 1 bar and 293 K. The fuel and inert gas were premixed in a T-mixer. The mixture reached the combustion zone with a laminar flow and homogeneous mixture. Laser-induced incandescence was generated by a frequency-doubled pulsed Nd:YAG laser and detected with a photomultiplier tube to obtain time-resolved LII signals. Adding 0.5 mg/s of Ar reduced the soot volume concentration to 93% of the original value, in the cases of $N_2$ and $CO_2$ the reduced values amounted to approximately 81%. Additional increments of inert gas in further steps of 0.5 mg/s resulted in the same tendency .

In consideration of primary particle sizes, nitrogen addition resulted in a considerable initial effect, while particle size in the case of carbon dioxide only changed significantly on the addition of larger flow rates.