

## **A HIGH TEMPERATURE ENDOSCOPE FOR CHEMILUMINESCENCE IMAGING IN COMBUSTION FACILITY**

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Experimental study and development of novel concepts of combustion in industrial boilers and furnaces require the use of advanced measurement techniques, especially optical diagnostics in laboratory-scale and semi-industrial scale facilities. Application of optical techniques in such configurations of high temperature confined combustion chambers suffers of the hot environment and the limited optical accesses. Following our previous development of high temperature endoscopic PIV for velocity measurements in furnace, we present the development of a new high temperature endoscopic system adapted to visible and ultraviolet spectral range for chemiluminescence imaging of flames.

The optical part of the endoscope consists in a series of 13 lenses divided in 5 groups where the first set is used to construct a real image with a low magnification ratio, whereas the 4 other groups act as optical relays to transport the image directly to the photocathode of an ICCD camera. The setup is equivalent to a 12.8 mm - f/3.9 objective lens, with a large collection angle. Coupling of the endoscope and the ICCD camera is made by a differential thread mechanism providing fine-focus adjustment. Spectral filters are set close to the camera front side to select OH\* chemiluminescence collection in UV, and then avoid thermal radiation from soots or hot walls on flame images.

The set of lenses is protected from high temperature environment by a stainless steel water-cooled jacket (length = 370 mm - ext. dia. = 76 mm), and a continuous nitrogen flow in front of the small entrance lens. During operation, the temperature of the front side of the endoscope is controlled thanks to a thermocouple. Efficiency of the nitrogen flow to protect the lens from heating and soots or dusts deposit is verified by hot wire anemometry in the vicinity of the exit, as well as by CFD simulation. Optical characteristics of the setup (field of view, depth of field, spatial resolution, distortion) are quantified from images of reference grids.

First series of flame imaging experiments with the high temperature endoscope are conducted on a laboratory-scale oxyfuel combustion facility. Its large optical accesses enable to make comparison with a standard imaging setup (same ICCD camera with commercial UV objective lens) and to demonstrate the adequacy of the high temperature endoscope to obtain OH\* chemiluminescence images.

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