THE ACCURACY COMPARISON BETWEEN INTENSITY BASED TECHNIQUE AND LIFETIME BASED TECHNIQUE FOR MEASUREMENT OF HIGH TEMPERATURE FIELD

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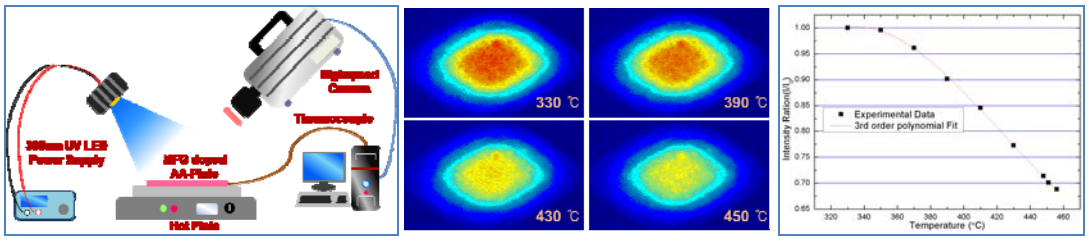
Fluid: air jet flow
Visualization method(s): laser-induced fluorescence (LIF)
Other keywords: intensity based calibration, lifetime based calibration

ABSTRACT: The accuracy of data analysis methods were compared between intensity based measurement technique and lifetime based measurement technique. The rare earth fluorescence material (MFG: Mg_4FGeO_6) was used for the optical temperature measurement at the high temperature range, higher than 300 degree Celsius, and it was applied to measure the temperature field generated by the air jet cooling. The Aluminum plate was anodized to make nano size pores on the material surface and the MFG dye was coated on the anodized aluminum plate (AA plate). Anodized aluminum plate with MFG dye was placed on the hot plate, which can be controlled until 450 degree Celsius. Fig. 1 (a) shows the experimental setup. The two kinds of LED light source, a continuous light source for intensity based measurement and a pulsed light source for lifetime based measurement, with 385 nm wavelength were used to exciting the MFG dye and the LED power was controlled with power supply. The CMOS high speed camera (Photron Fastcam SA1.1) was adopted to acquire images and the surface temperature of aluminum plate was monitored by thermocouple. The 590 nm long-pass filter was installed on the 60mm lens to filtering the whole light except luminescence light. To compare the accuracy of data analysis methods, the intensity based pixel by pixel calibration and lifetime based calibration were applied. Fig. 1 (b) and (c) is the data for pixel by pixel calibration. Fig. 1 (b) shows the intensity contour of calibration images. The intensity was decreasing when the temperature of plate is increasing. 1000 images were acquired and they were ensemble averaged. The calibration curve was calculated from the ensemble averaged calibration image. Due to the characteristics of calibration data, third order polynomial fitting was applied to get the calibration curves were acquired. Fig. 1 (c) demonstrates one of the curves at a pixel (603, 784). The temperature field was obtained by using intensity based and lifetime based calibration method.



(a) (b) (c)

Fig. 1 Experimental setup and calibration result; (a) Experimental setup for optical temperature measurement, (b) Intensity contour of calibration images, (c) Temperature-Intensity calibration at (603, 784) Pixel

References

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