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Fluid flow thermometry using thermographic phosphors

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ABSTRACT

Phosphor thermometry is a non-intrusive thermometry technique that allows for spatially and temporally resolved surface temperature measurements. The thermographic method has been employed in a number of applications that include combustion, sprays, and gas flows. In the current work, we investigate the implementation of thermographic phosphors in liquid flows, which is of interest in a wide range of applications in heat transfer, fluid mechanics, and thermal systems. Zinc oxide doped with Zinc (ZnO:Zn) was the phosphor employed for experimentation due to its high emission intensity and insolubility. In order to explore this application, the phosphor powder was uniformly dispersed in water using a magnetic stirring rod. The phosphor was excited by the third harmonic 355 nm output of a Nd:YAG laser, and the luminescence was examined using a fiber-coupled spectrometer. Analysis of the spectral data showed a significant redshift as the temperature approached boiling point. Further characterization of effects of temperature and experimental parameters such as ZnO:Zn concentration on the luminescence signal was performed.

KEYWORDS

Phosphor thermometry, fluid flow, zinc oxide, laser diagnostics