Thermographic Particle Image Velocimetry in flames: current state of the technique

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HIGHLIGHTS

• Thermographic phosphor particles are used as a tracer for simultaneous temperature and velocity imaging in turbulent flames.
• The phosphor BAM:Eu++ is probed in laminar H2/N2 diffusion flames to assess its upper temperature limit for a given particle seeding density.
• To determine if the particles are damaged by the flame, they are probed in the diluted exhaust gases of a pure hydrogen diffusion flame.
• The pre and post-flame luminescence signals of the particles are similar, demonstrating their utility in post-flame events and recirculation burners.

ABSTRACT

Thermographic Particle Image Velocimetry is a laser-based measurement technique for joint temperature and velocity imaging technique that is based on thermographic phosphor tracer particles. Since most thermographic phosphors are inert, have a high melting point, and are insensitive to the gas composition, there is clearly potential for combustion-related applications.

In this study, the thermographic phosphor BAM:Eu++ is seeded in laminar non-premixed flames, to investigate the temperature limit for flame studies. Simultaneous temperature and seeding density measurements show that due to the thermal quenching of the luminescence emission, measurements are not possible above 900-1000 K, where the luminescence signal disappears for a local seeding density of 3 x 1010 particles/m. Phosphor particles are also seeded into a pure hydrogen diffusion flame and probed 20 cm downstream, after the exhaust gases are cooled down by dilution. Measurements show that the luminescence properties of the particles were unaffected by their journey through the flame. BAM:Eu++ particles can therefore be used for measurements in exhaust gases of reciprocating engines, or in burners with recirculation.

![Fig. 1](left-right) temperature, luminescence intensity and seeding density measurements in a diluted H2/N2 laminar diffusion flame using BAM:Eu++ thermographic phosphor particles.