- IFSA2025 –

Luminescent concentrators as reflectivity source for emissivity measurement in WDM regime

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Luminescent concentrators are incoherent sources based on spontaneous emission guided by total internal reflections in a parallelepiped polished on all faces. These sources present an unique combination of high power and high brigthness and could emit on a broad spectral band.

Recently, we have demonstrated that a LED-pumped Ce:YAG luminescent concentrator is adapted to calibrate a streak optical pyrometer at the ns scale. Its brightness and stability properties helps also to reduce the uncertainty of temperature measurements by a factor 2.5 compared to classical calibration methods. This new method of calibration was employed at the LULI facility in 2023 and provided control over calibration uncertainties for quartz shocked around 1eV.

As a consequence, the emissivity uncertainty becomes significant for the gray body temperature measurement. We therefore propose a method for measuring emissivity, based on the Kirchhoff law, with the optically thick materials hypothesis: $\varepsilon+\rho=1$ with ε the directional emissivity (on the SOP axis) and ρ the hemispherical reflectivity. By measuring the reflectiviy, we can therefore deduce the value of the emissivity.

For this purpose, the brightness of the light source has to be large enough such that the reflected signal is much higher than the emission of the gray body. In addition, it has to be spectrally broadband in order to scan the emissivity over a broad spectrum. Our recent experiments show that luminescent concentrators can fullfill this requirement. We have demonstrated luminance of several 10kW/cm²sr between 420 and 620nm with a stack of luminescent concentrators. The high luminance already obtained and the future improvements will allow us to measure emissivity with controlled uncertainties on a wide spectrum.