

Popular Description on Master's thesis work:

Development of Spectroscopic Measurements for Raman and Thomson Scattering Diagnostics

——Applications in Combustion and Plasma

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Combustion is a commonly used physical phenomenon in our daily life, from cooking to driving, heating and manufacturing. Typically, combustion starts to happen when fuel is mixed with an oxidant (usually oxygen in the air) and reaches a critical temperature. The process usually contains a complicated sequence of chemical reactions and also gives out intensive heat and light. As an important scientific task, significant research effort has been focused on understanding the physical and chemical processes in combustion.

Plasma is one of the fundamental states of matter in which an ionized substance becomes highly electrically conductive. Lightning is an example in nature of a partially ionized plasma. Plasma can be artificially generated as well. When electric current flows through a gaseous medium, gas discharge occurs and plasma is generated. Measuring the parameters of such laboratory plasma, termed plasma diagnostics, helps researchers to understand the physical phenomena.

Optical spectroscopy has played a significant role in many research fields, including combustion and plasma diagnostics. The interaction between matter and light can provide considerable amount of useful information. Therefore, specific light sources, such as lasers, can be employed as a probe to study the object of interest. With the advent of laser techniques, it is possible to achieve in-situ and non-invasive investigations with high spatial and temporal resolution. Raman spectroscopy is a diagnostic method based on Raman scattering, which is an inelastic light matter interaction. When light interacts with molecules, an energy exchange will take place between a photon and a molecule and the photon will scatter off with a different energy. The energy change of the photon coming in and out is determined in accordance with the species, providing a specific fingerprint on the spectrum. Similar to Rayleigh scattering, Thomson scattering is an elastic scattering process when light is scattered by charged particles, A Thomson scattered spectrum is broadened and important information of the plasma can be extracted from it.

However, spectroscopy suffers from interferences called stray light. Stray light in an optical system can be described as light that deviates from the intended path and ends up in the wrong place. In spectrometers, stray photons will distort the characteristics of the measured spectrum. Therefore, stray light can be a notable problem in spectroscopy, in particular when the spectral component of the signal-of-interest is near another strong spectral peak. The elimination or correction of stray light is desired in spectroscopic experiments. Several solutions to this problem have been developed at the Division of Combustion Physics at Lund University. This thesis work aims to apply such methods in Raman- and Thomson scattering measurements and also to test and demonstrate the performance.