HIGH-RESOLUTION LIF-IMAGING OF THE OIL FILM THICKNESS IN THE PISTON-RING / CYLINDER-LINER CONTACT IN AN OPTICAL TRIBOMETER

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ABSTRACT
The sliding contact of the piston-ring / cylinder-liner assembly (PR/CL) is a major contribution to the frictional power losses in an IC engine, accounting for 45 % of the engine’s friction losses [1]. In order to further reduce these losses and improve the engine efficiency, we need to better understand the lubricant film’s distribution and dynamics in the contact. Here, a rotational tribometer is used as a model experiment for the PR/CL. It allows investigating the frictional behavior corresponding to global engine operating conditions such as speed, load, and temperature.

One of the main purposes of this model experiment is to use laser-induced fluorescence (LIF) to image the thickness of the oil film between the liner and the piston-ring segment with high spatial and temporal resolution in two-dimensions. For optical access to the contact area, one of the sliding bodies needs to be replaced by a transparent material. In our previous work, in the tribometer this was achieved by a quartz liner [2] or, in a single-cylinder engine, by a sapphire window mounted in the cylinder wall [3]. With this arrangement, the lubricant behavior can be examined with various piston ring surfaces, but the liner surface material must be quartz or sapphire.

In order to investigate the oil-film on liner surfaces as they come from the production line, a new arrangement was developed in this work. As shown in Fig. 1, optical access is created via a sapphire piston-ring segment and a periscope-like mirror arrangement. This allows LIF imaging of the lubricant on a conventional cylinder liner surface, rarely studied in previous works, such as gray cast-iron liner after honing or with a thermally sprayed iron-based coating with fine pores.

REFERENCES