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.

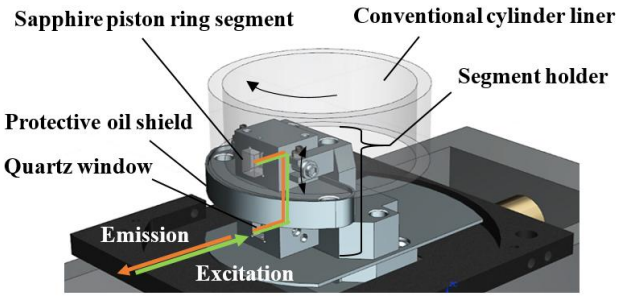

Fig. 1 Optical access in the rotational tribometer for oil-film visualization on a commercial liner surface.

This paper presents the newly developed optical arrangement in the rotational tribometer and results from LIF oil-film imaging. First tests show that the cylinder liner's honing structures as well as the surface pores of sprayed liner coatings can be well resolved. Based on these images, the influence of various test parameters and different liner surface structures on the oil-film behavior and on the minimum oil-film thickness in the contact area is discussed.

REFERENCES
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