THE RECIPROCATING SLIDING FRICTION BEHAVIOR AND WEAR STATE TRANSITION MECHANISM OF CYLINDER LINER AND PISTON RING

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KEYWORDS

Friction; Wear; Surface topography, Cast iron materials

ABSTRACT

The cylinder liner piston ring is an important friction pair in internal combustion engines. Its friction and wear properties directly affect the reliability and service life of internal combustion engines. Cast iron is one of the most widely used cylinder liner materials because of its excellent wear resistance due to its complex composition and microstructure. The microstructure composition directly affects the friction and wear properties of cast iron. However, there are few reports on the synergistic effect of different microstructures on the wear process. In this study, the cylinder liner piston ring was taken as the research object, and the enhanced wear experiments under extreme conditions were carried out on a multifunctional friction and wear tester. The surface and interface morphologies of the cylinder liner at different wear stages were analyzed by white light interferometer, scanning electron microscope (SEM), and transmission electron microscope (TEM). The wear time-varying characteristics of the cylinder liner piston ring at different wear stages and the synergistic effect of different microstructures in the wear degradation process were studied. The results show that the wear process of cylinder liner cast iron will go through three stable stages: low friction stage ($\mu \leq 0.3$), stable friction stage ($0.35 \leq \mu \leq 0.45$), and high friction stage ($0.5 \leq \mu$) (μ is the friction coefficient). The low friction stage is mainly due to the self-lubricating effect of graphite, resulting in a lower friction coefficient and wear rate. In the stable friction stage, due to the formation of the surface enamel layer, the graphite is difficult to overflow, and the pearlite of the matrix structure begins to undergo abrasive and adhesive wear. Due to the shedding of the phosphorus eutectic in the high friction stage, the surface enamel layer is worn in a lamellar form, resulting in a higher wear rate.

In this study, the synergistic effect of different microstructures of cylinder liner cast iron at different wear stages was analyzed, and the wear degradation law of cylinder liner cast iron was revealed from the microstructure perspective. This is of great significance for the wear prediction of the cylinder liner piston ring and the optimization of the cylinder liner cast iron microstructure.

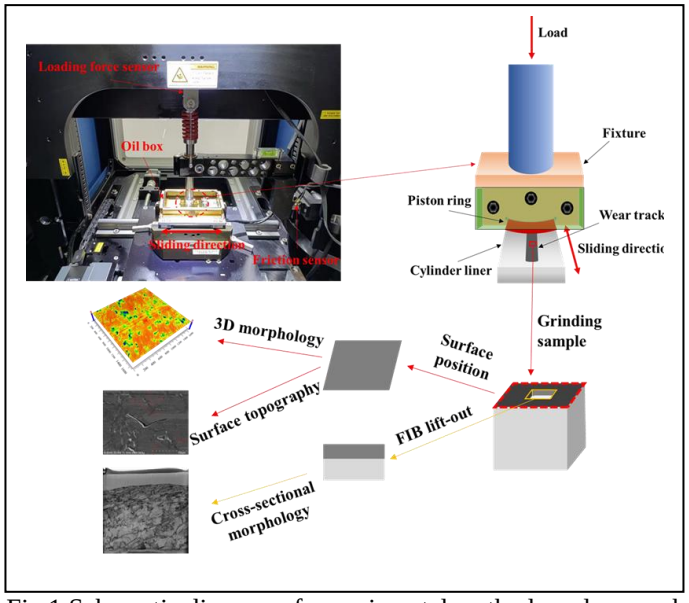

Fig.1 Schematic diagram of experimental methods and research process

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