Tribological Properties of PTFE / Laser Surface textured Stainless Steel under Lubrication

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1. Introduction

The reduction of friction and wear is considered to be a necessary requirement for saving energy, prolonging durability and improving efficiency. Laser texturing technology as a means for enhancing tribological properties is well known for many years [1,2]. In this paper, the tribological properties of textured stainless steel rubbing against PTFE were investigated by ring-on-disc friction test.

2. Experimental methods

The stainless steel disc (1Cr18Ni9Ti) with diameter of 48mm and roughness (Ra) of about 0.1μm was textured by a pulsed Nd:YAG laser. The PTFE ring (Φ46mm*8mm), which was polished to the roughness （Ra） less than 0.05μm, was used as counterface.

The friction tests were carried out by using a MG-2000 tribological tester. Upper PTFE ring was fixed and contacted with rotating laser-texturing stainless steel disc

3. Results and discussion

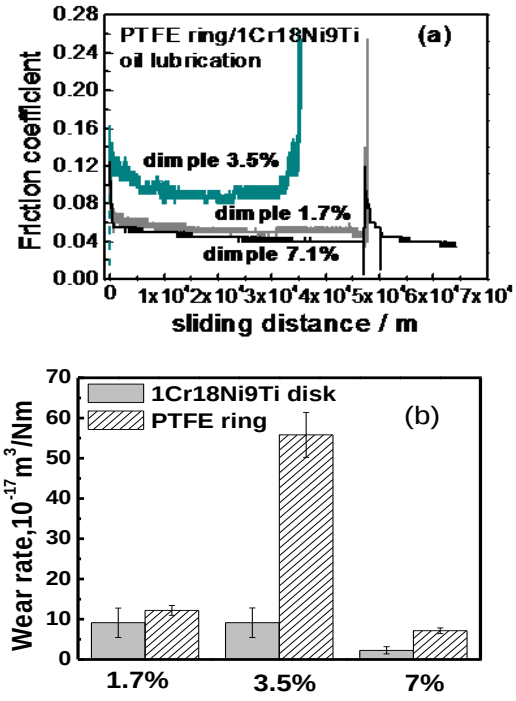

Fig.1 Friction coefficients(a) and wear rate(b) of textured steel under oil lubrication

Fig.1 shows the friction coefficient and wear rate of textured sample with different dimple density. The texture with 7.1% dimple density shows the lowest friction coefficient and longest wear life. Its friction coefficient is kept at 0.045 for more than 65,000m (Fig.1(a)). The friction coefficient of textured sample with dimple density of 3.5% is about 0.08～0.10 and its stable friction coefficient sustains only about 35,000 m. The wear rate of stainless steel and PTFE for dimple density of 7.1% is also lower than that of other dimple density (Fig.1 (b)).

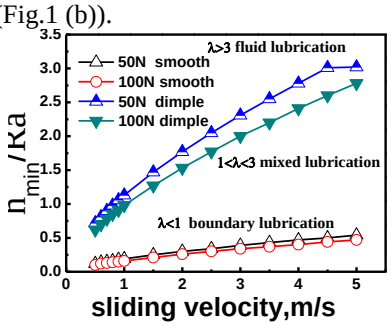

Fig.2 The film thickness ratio of smooth and textured mates

As is shown in Fig.2, most of the friction mates are in the state of boundary lubrication when the low velocity is smaller than 0.8m/s. In the same velocity, the film thickness ratio decreased step by step along with the increase of load(λ). In the same load, the film thickness ratio is increased along with the accretion of sliding velocity. The film thickness ratio between the textured mates contact surfaces is larger than that of smooth mates.

4. Conclusions

With laser texturing, the friction and wear were reduced and the boundary lubricating state transformed to hydrodynamic was improved. The dimpled-samples are effective in reducing friction and enhancing the wear life of oil film.

5. References

[1] Pettersson U, Jacobson S. “Influence of surface texture on boundary lubricated sliding contacts”. Tribology International 2003;36: 857–864.

[2] Etsion I, Halperin G. A. “laser surface textured hydrostatic mechanical seal”. Sealing Technology 2003;3:6-10.