

EFFECT OF WEAR RESISTANCE PROPERTIES OF ION-PLATED COATINGS ON CAM FOLLOWER WEAR

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1. INTRODUCTION

Nowadays, automotive engine cam follower materials must meet an increasingly rigorous requirement for low wear rates under severe operating conditions. Therefore, many types of wear-resistant materials have been adopted for cam followers, especially for sliding rocker arm pads(1). These materials include ferro-based powder metals with a high chromium content, high chromium cast irons and silicon nitride ceramics.

In this research, the wear resistance of die tool alloy steel followers coated with ion-plated films of Cr-N, Cr₂N or TiN (2) was compared with that of followers made of ferro-based powder metal(P/M) and conventional carburized steel with a surface phosphate coating.

2. TEST CONDITIONS

The main specifications of the follower materials used in the test are shown in Table 1. The cam material was a low alloy chilled cast iron commonly used for camshafts.

Wear evaluation motoring experiments were performed with a test rig that simulated a direct-acting type of valve train having a single cam lobe mating with the follower, a round plate shim on the lifter. In order to accelerate scuffing wear at the cam-follower interface, a much higher valve spring load, a low cam speed, and a low oil temperature were used.

3. RESULTS AND DISCUSSION

The wear amounts following the test are shown in Figure 1. These results confirmed the superior wear resistance of shim followers coated with Cr-N or Cr₂N, whereas shims coated with TiN and P/M shims accelerated cam wear, and the carburized shim itself wore severely.

Close observation of the follower surfaces revealed coarse surface roughness caused by delamination in the case of P/M and by abrasion in the case of TiN. The carburized steel follower wore deeply with severe scuffing. On the other hand, Cr-N and Cr₂N surfaces showed little roughness and no severe damage. The smooth surface suggests that wear acceleration was restrained.

Table 2 Test conditions

Cam Speed	3 0 0 r p m
Contact Pressure	1 4 4 0 M P a
Lubrication	7.5W - 30 S F
Oil Temperature	323 K (50 °C)
Duration	5 0 h

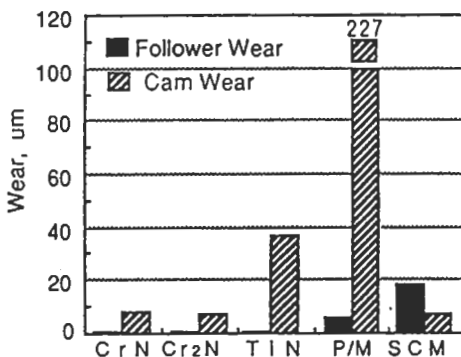


Fig.1 Cam and follower wear amounts

4. CONCLUSION

The superior wear resistance of shim followers coated with Cr-N or Cr₂N was confirmed in accelerated scuffing wear tests. Shims coated with TiN and P/M shims accelerated cam wear, and the carburized shim itself showed severe wear.

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REFERENCES

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Table 1 Follower materials

Shim	Material (Main element) wt%	Heat Treatment	Roughness	Hardness
Cr-N	Base metal: Fe-12Cr Die Steel	Ion Plating	Ra 0.06	HRC 59
Cr ₂ N	Base metal: Fe-12Cr Die Steel	Ion Plating	Ra 0.11	59
TiN	Base metal: Fe-12Cr Die Steel	Ion Plating	0.12	60
P/M	Fe-16Cr-4Mo-3C Powder Metal	Sintering	0.59	64
SCM	Fe-0.8Cr-0.2Mo Carburized Steel	Carburizing & phosphate coating	1.13	62