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Wear Behaviour Related to Microstructure of Ni₃Al-Based Alloys

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Table1. The Test Materials

Marka

Composition

Drocogg

The tribological behavior of materials plays an important role on performance of the internal combustion engines. Due to their intrinsic long-range ordered crystalline structure with strong oriented atomic bonding and high workhardenability. In this work, the wear behavior of an existed Ni3Al-based alloy and its composites were studied, and related to their microstructures.

Testing Materials

An iron-added NAC-alloy and its Cr3C₂ reinforced composites were selected for investigation. The composition of the NACalloy is Ni-18.8Al- 10.7Fe-0.5Mn-0.5Ti-0.2B (at.%). The tested bulk-materials were produced by Hipping and vacuum melting processes, respectively.

Tarks	Composition	Process
1#	NAC-alloy	HIP
2#	NAC-alloy + 6 vol.% fine Cr ₃ C ₂ particles	HIP
3#	NAC-alloy + 6vol.% coarse Cr_3C_2 particles	HIP
4#	NAC-alloy	As-cast

Table 2. Scuffing loads of the tested materials by Pin-on-Disk

Tested material Specimen 1#

* $1bar = 1.020 \text{ kg/cm}^2$

Scuffing load (bar)*

The NAC-alloy powders were prepared by a plasma-rotating-Electrode-Process (PREP) equipment.

Wear Test

Speemen 1	/ 220	
Specimen 2#	> 220	
Specimen 3#	>220	
Specimen 4#	≤150	
Darcastiron	≤ 100	

Pin-on-Disk tests under the different loads were carried out in the work. The disk material is a standard Tarkalloy-C casting iron. Darcast cast-iron was tested also as a reference material. The Scuffing resistance of the tested materials was also investigated by Pin-on-Disk method in this study.

Analytical Experiments

Scanning Electron Microscope, Energy Dispersive Spectrometer and X-ray diffractometer were applied to identify the phase constitution and microstructure of the tested materials. And then, the analytical results were related to their tribological performances.



Conclusions

Ni3Al-based materials have reasonable low sliding wear-rate and rather high scuffing resistance, compared to the tranditional wearresistant cast-iron, especially the carbide reinforced composites.

NiAl-phase existed on the Ni3Al-matrix made the materials having a worse scuffing resistance. And the phase constitutions was related to metallurgy preparation processes.

Fig.1Two backscattering electron images of the specimens1#(a),and 4#(c). And The diffraction spectrum revealed that only a Ni₃Al-type single phase existed in the Hipped 1#(b)specimen. But the diffraction spectrum (d) from the specimen 4# clearly showed that two phases existed in the material. The {110 } diffraction peak of NiAl-phase was also shown in the spectrum, as in the spectrum of as cast material.

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