Wear Behaviour Related to Microstructure of Ni3Al-Based Alloys

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Objective

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 work-hardenability. 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 NAC-alloy 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.

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

Wear Test

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 wear-resistant 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.

Table1. The Test Materials

Marks	Composition	Process
1#	NAC-alloy	HIP
2#	NAC-alloy + 6vol.% fine Cr_3C_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	Scuffing load (bar)*
Specimen 1#	>220
Specimen 2#	> 220
Specimen 3#	>220
Specimen 4#	≤150
Darcastiron	≤ 100

* 1bar = 1.020 kg/cm2

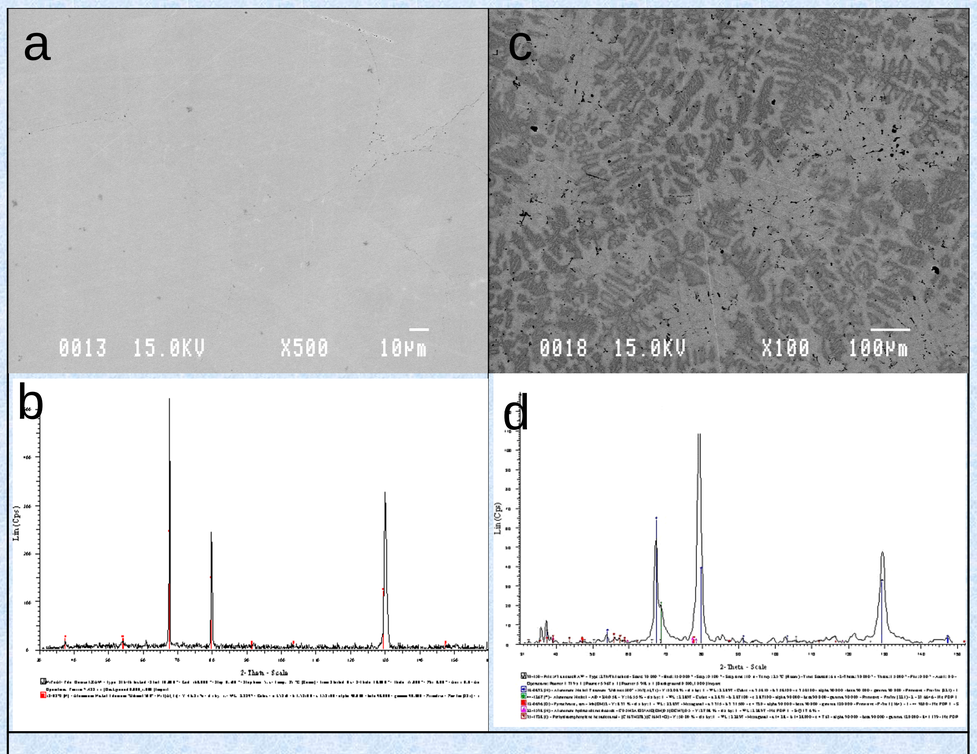

Fig.1Two backscattering electron images of the specimens1#(a),and 4#(c). And The diffraction spectrum revealed that only a Ni_3Al-type single phase existed in the Hipped 1#(b)specimen. But the diffraction spectrum (d) from the specimen 4# clearly showed that two phases existed in the material. The {110 } diffraction peak of NiAl-phase was also shown in the spectrum, as in the spectrum of as cast material.

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