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Development of High Corrosion Resistant Mo_2NiB_2 Boride Base Cermets for Plastic Injection Molding Machine Parts

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Abstract

Injection molding of corrosive super engineering plastics and engineering plastics with various fillers is conducted under severe conditions and causes corrosion and wear problems. We have developed Mo_2NiB_2 boride base cermets, which have excellent corrosion- and wear- resistances, and tried to apply them into plastic molding machine parts. Iin this paper, the effects of V substitution for Cr on the mechanical properties, corrosion resistance and microstructure of Ni-5.0B-51.0Mo-(17.5-X)Cr-XV (mass%) model cermets were investigatied.
Both transverse rupture strength (TRS) and hardness increased monotonically with increasing V content and reached 2.94GPa and 87.2R_A at 10.0%V, respectively. The improvements of TRS and hardness were attributed to microstructural refinement.

Keywords : Mo_2NiB_2 boride base cermets, ternary boride, cermet, mechanical properties, corrosion resistance

1. Introduction

Recently, super engineering plastics containing various kinds of fillers and a very corrosive fluorocarbon resin are increasing in plastic injection molding. Injection molding machine parts used in severe molding conditions requires excellent mechanical properties and corrosion resistance.

The Mo_2NiB_2 boride base cermets consist of Mo_2NiB_2 type complex boride as a hard phase and a Ni base binder, and show good mechnical properties, excellent corrosion- and wear-resistances [1-3]. The applicability of the Mo_2NiB_2 boride base cermets into injection molding machine parts was investigated by optimizing alloying elements. Consequently, it was revealed that Ni-5.0B-51.0Mo-17.5Cr (mass%) cermet exhibited excellent corrosion resistance for molten fluorocarbon resin, which is comparable to superalloy Hastelloy C [4]. Especially V substitution for Cr improved the mechanical properties such as transverse rupture strength (TRS) and hardness of Ni-5.0B-51.0Mo-(17.5-X)Cr-XV (mass%) cermets. However, the precise mechanism about improvements of mechanical properties has not been fully understood although it is obvious that the mechanical properties of Mo_2NiB_2 boride base cermets are strongly affected by the microstructure.

This paper focuses on the effects of V substitution for Cr on the mechanical properties and microstructure of Ni-5.0B-51.0Mo-(17.5-X)Cr-XV (mass%) model cermets in order to understand improvements of mechanical properties by clarifying the structure-property relationship.

2. Experimental and Results

The compositions of Ni-5.0B-51.0Mo-(17.5-X)Cr-XV (mass%) model cermets with five levels of Cr and V contents were used in this study. The powder mixtures prepared from raw powders were ball-milled in acetone to an average particle size of about 1μm. After drying, the milled powders were pressed to green compacts and sintered in vacuum for 1.2ks at temperatures between 1513 and 1593 K. Transverse rupture strength (TRS) and Rockwell "A" hardness of the cermets were measured. The microstructure of the sintered cermets was investigated by means of X-ray diffraction (XRD), scanning electron microscopy (SEM) and scanning auger electron spectroscopy (AES).

Fig. 1 shows TRS and hardness at the optimum sintering temperature, where the maximum TRS is obtained at each composition, as functions of Cr and V contents. Both the TRS and the hardness increase monotonically from 2.27 to 2.94GPa and from 85.3 to 87.2R_A with increasing V content, respectively.

Fig.2 shows microstructures of the model cermets by the

back-scattered electron images (BEIs). The Ni base binder and the M_3B_2 (M:Metal) complex boride phase appear dark and gray, respectively. These BEIs also indicate that the particle size of M_3B_2 type complex boride become small with increasing V content. Moreover, white third phase is observed in V containing cermets.

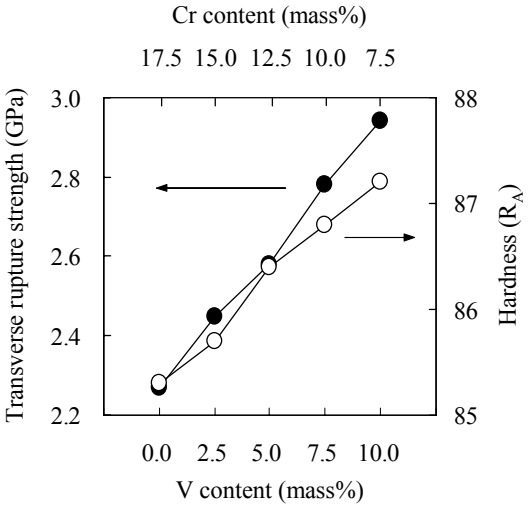

Fig. 1. Transverse rupture strength and hardness of Ni-5.0B-51.0Mo-(17.5-X)Cr-XV (mass%) cermets as functions of Cr and V contents.

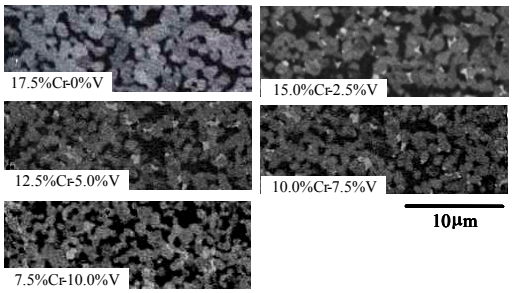

Fig. 2. Back scattered electron images of Ni-5.0B-51.0Mo- (17.5-X)Cr-XV (mass%) cermets.

3. Summary

Both the TRS and the hardness increased monotonically with increasing V content and reached 2.94GPa and 87.2R_A at 10.0%V, respectively. V substitution for Cr in the model cermets improved mechanical properties and refined microstructure.

4. References

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