Metal Injection Molding Process of Mo_2FeB_2 Boride Base Cermets

Hirofumi Tashiro[1,a], Kourou Hirata[1,b], Yuji Yamasaki[2,c], and Ken-ichi Takagi[3,d]

[1]Technical Research Laboratory, Toyo Kohan Co., Ltd, 1296 Higashitoyoi, Kudamatsu 744-8611, Japan
[2] Hard Material Department, Toyo Kohan Co., Ltd, 2-12 Yonbancho, Chiyoda-Ku Tokyo, 102-8447 Japan
[3]Department of Mechanical Engineering, Faculty of Engineering, Musashi Institute of Technology,
1-28-1 Tamazutsumi Setagaya-ku Tokyo, 158-8557 Japan
[a]email: u5371@toyokohan.co.jp, [b]email: u6039@toyokohan.co.jp
[c]email: u5052@toyokohan.co.jp, [d]email: ktakagi@sc.musashi-tech.ac.jp

Abstract

Mo_2FeB_2 boride base cermets produced by a novel sintering technique, called reaction boronizing sintering through a liquid phase, have excellent mechanical properties and wear and corrosion-resistances. Hence, the cermets are applied to the injection molding die-casting machine parts and so on.

We investigated that the effect of deoxidization and sintering temperature on mechanical properties and deformation of the MIM processed cermets. As a result, deoxidization temperature of 1323K and sintering temperature of 1518K were suitable. The MIM products of the cermets showed allowable dimensional accuracy and the same mechanical properties as the press-sintered ones.

Keywords : MIM, **ternary boride, cermet, Mo_2FeB_2, mechanical properties**

1. Introduction

Recently, a reaction boronizing sintering has been developed. It has potential utilities of the outstanding characteristics of the metal borides as ternary boride base cermets with full density and excellent mechanical properties and wear and corrosion-resistances[1]. These cermets were based on Mo_2FeB_2[2] and Mo_2NiB_2[3]. Mo_2FeB_2 complex boride-based cermets are the first boride base composite that has comparable mechanical properties to the cemented carbide.

In this study, the MIM process was applied to produce the Mo_2FeB_2 boride base cermet parts, and mechanical properties of the MIM cermet parts were compared with those of commercial press-sintered ones.

2. Experimental and Results

Table 1 shows the composition of boride base cermet used in this study. Raw materials were ball-milled in aceton for 24 hours. After drying, the milled powder was mixed with a binder, which consisted of paraffin wax and APP (atactic polypropylene). The binder content of the powder mixture was about 55 vol%. The injection molding was performed at 433K with 170MPa injection pressure. The dimension of used mold was 35x30x2mm. The mold was heated to a temperature of 318K. The molded specimens were dewaxed, deoxidized and sintered contineously in the same furnace. The effect of deoxidizing and sintering temperatures on relative density of the sintered compact was studied. The transverse rupture strength (TRS) and Rockwell "A" hardness (R_A) of the sintered compacts were measured.

Table 1. Powder composition

Element	Mo	Cr	W	Ni	B	Fe
wt%	39.00	8.20	3.80	2.85	4.70	bal

Fig.1 shows the relation between deoxidization temperature and relative density sintered at 1533K. The relative density of the samples deoxidized at 1298K and 1323K are close to 100%, but it decreases when the deoxidization temperature increases over 1323K. It is considered that when the deoxidization temperature is high, the sintering reaction starts before completing deoxidization, and oxides and carbides are formed. As a result these compounds decrease the relative density of the sample.

The TRS and the R_A of the sintered compacts are shown in Fig.2 as a function of sintering temperature. Both the TRS and the R_A from 1518K to 1548K show almost all the same values as those of press-sintered samples, whose TRS and R_A are about 2000MPa and 85~86R_A respectively. When the sample sintered at 1503K, the TRS decreased drastically because the sintering did not finish completely at this temperature. Thus, a deoxidization temperature of 1323K and a sintering temperature of 1518K or more are suitable for obtaining the same mechanical properties as those of the press-sintered ones.

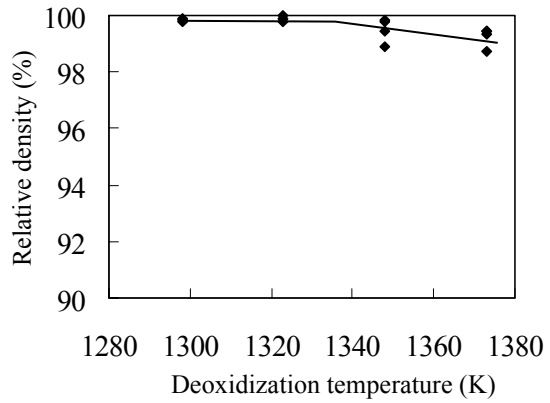

Fig. 1. Relationship between deoxidization temperature and relative density.

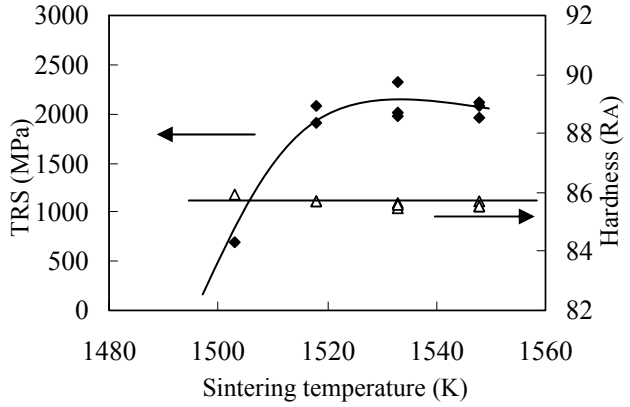

Fig. 2. TRS and hardness as a function of sintering temperature.

3. Summary

In this study, we tried the MIM process to produce Mo_2FeB_2 boride base cermet parts, and found the suitable condition for obtaining the same mechanical properties as those of the press-sintered ones.

4. References

1. K.Takagi, M.Komai, S.Matsuo, :Proceedings of 1994 Powder Metallurgy World Congress (PM'94), SF2M and EPMA, Les Editions de Physique Les Ulis, France, Vol.1(1994)227-234
2. K.Takagi, S.Ohira, T.Ide, T.Watanabe, Y.Kondo, :Met. Powder Rep., 42 (1987) 483-490.
3. M. Komai, Y.Yamasaki, K.Takagi, T.Watanabe, :Properties of emerging P/M material, in: J.M. Capus, R.M. German (Eds.), Advances in Powder Metallurgy and particulate Materials, Metal Powder Industries Federation, Princeton, NJ, Vol.8(1992)81-88.