텅스텐-니켈-망간 합금의 액상소결에 관한연구
(A Study on the Liquid Phase Sintering of Tungsten-Nickel-Manganese alloy)

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Liquid phase sintering of 90W-6Ni-4Mn alloy has been investigated as functions of sintering atmosphere, heating rate, and reduction temperature. The present work accounts for the thermodynamic oxidation/reduction reactions of constituent powders of W, Ni and Mn. By discounting these reactions, the previous investigations would obtain only the alloy with large pores and the lowered relative sintered density, by the liquid phase sintering under a dry hydrogen atmosphere. the sintering cycle consisted of a rapid heating to reduction temperatures under high purity nitrogen atmosphere, and holding for 4 hours and sintering at 1260℃ for 1 hour under a dry hydrogen gas. The relative density of the sintered alloy increased with increasing heating rate. As the reduction temperature increased, the relative density increased to the 100% theoretical density at the reduction temperature above 1150℃. The microsturcture of sintered alloys has been analysed by a scanning election microscope. The sintered density was compared with those obtained from the other investigators. It was found that the reduction 1150 ℃ results in the lowered densification of 90W-6Ni-4Mn alloy. This is caused by the fact that reducing reactions of W and Ni oxides contained in W an Ni powders concomitantly leads to oxidizing reaction of Mn powder the oxidized Mn is hardly reduced at sintering temperature and thereby remains large pores in the alloy. It is concluded that the W-Ni-Mn alloy with full density can be obtained by the precise control of atmosphere, heating rate, and sintering temperature.