# MAGNETIC PROPERTIES OF FINE IRON-COBALT-BORON PARTICLES*

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## Introduction

Ultrafine iron-cobalt-boron and iron-boron particles have been synthesized in the past by using $NaBH_4$ to reduce iron and cobalt salts to Fe-B and Fe-Co-B powders. Kim and et al.[1] have reported a maximum saturation magnetization of 130 emu/g for their Fe-Co-B system while Dragieva et al.[2] have obtained a maximum coercivity of only 850 Oe in the same system. These properties make the powders attractive for magnetic recording media. As a part of our program on ultrafine magnetic particles we have decided to investigate these systems in more detail.

## Experimental Method

A "Y" junction was used to mix solutions of $NaBH_4$ and metal salts. An external magnetic field of 1 kOe was applied during reaction. After the reaction, the resulting precipitates were separated and washed repeatedly with water and acetone and then dried in $N_2$ atmosphere. A SQUID magnetometer was used to measure the magnetic properties of the particles. A JEOL 100 C transmission electron microscope was used to determine the particle size.

## Results and Discussion

The particle size of the powders produced was in the range of 75-600Å. Figure 1 shows the saturation magnetization ($M_s$) and coercivity ($H_c$) as a function of reaction temperature. As the reaction temperature increases, $M_s$ of the particles decreases while $H_c$ goes through a maximum at around 40°C. Transmission electron micrographs verified previous observations which showed a smaller particle size at higher reaction temperatures. The larger $H_c$ may be due to the decrease of particle size as it approaches that of the single domain particle. The decrease in $M_s$ may be attributed to oxidation of smaller particles as indicated by chemical analysis.

Our values of $H_c$ and $M_s$ are much higher than those obtained previously. The reasons for this discrepancy are not quite clear at present. However, x-ray diffraction studies showed that our samples are crystalline (bcc α-Fe) as compared to the amorphous powders reported previously. We are presently trying different compositions in an attempt to reproduce and understand the magnetic and phase behavior of our powders.

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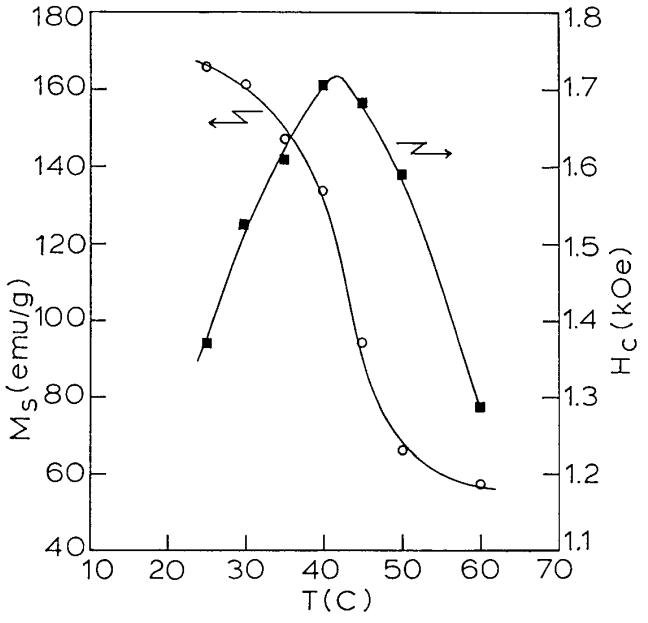


Figure 1. Saturation magnetization and coercivity as a function of reaction temperature.

## References

1. Kim, S.G. and J.R. Brock, J. Colloid and Interface Science, 116, 431 (1987).

2. Dragieva, G. Gavrolov, D. Buchkov and M. Slavcheva, J. Less-Common Metls, 67, 375 (1979).