

MICROSTRUCTURAL CHARACTERIZATION OF Nd-Fe-B MATERIALS

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Since the discovery of NdFeB permanent magnets¹ there has been a considerable amount of research undertaken in an attempt to understand their microstructures and magnetic properties, with a view to improving them. In the present work, the microstructure of an alloy with a composition of Nd₁₆Fe₇₆B₈ has been investigated using scanning electron microscopy (SEM). The microstructure of the as-cast alloy (fig.1) can be seen to be columnar in nature. There is no indication of any iron dendrites and the majority phase is the Nd₂Fe₁₄B (ϕ) phase surrounded by Nd-rich phase and Nd_{1+\epsilon}Fe₄B₄ boride phase (light). As expected the matrix phase (Nd₂Fe₁₄B) was found to be close to the composition Nd_{11.8}Fe_{82.4}B_{5.8}.

A sintered magnet has been prepared using the hydrogen decrepitation (HD) process² and the powder metallurgy route. Figure 2 shows the demagnetization curves of the Nd₁₆Fe₇₆B₈ HD sintered magnet (BH_{max}=38.24 MGOe) prepared from the as-cast ingot. The microstructure of the sample was also studied by SEM (+EDX) and reveals a morphology consisting of the majority Nd₂Fe₁₄B matrix grains, the boron-rich phase (Nd_{1+\epsilon}Fe₄B₄) and the Nd-rich phase. The volume percentages of the three phases were similar to those found in the cast ingot. Very occasionally, there were some randomly distributed (Nd, Fe) oxide precipitates (0.8 - 2.2. mm in size) in the Nd₂Fe₁₄B matrix grains. These oxides also occurred at the boundaries between the matrix grains and the boron-rich grains.

References

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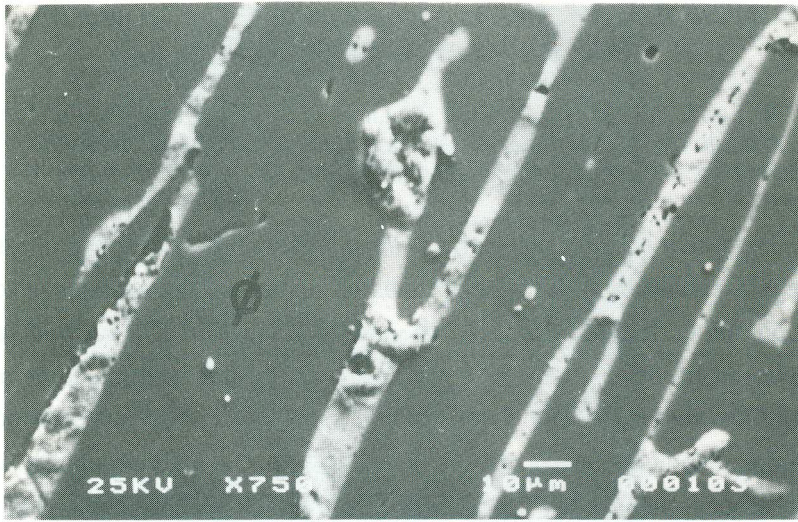


Fig.1 Microstructure of the as-cast ingot of the $Nd_{16}Fe_{76}B_8$ alloy.

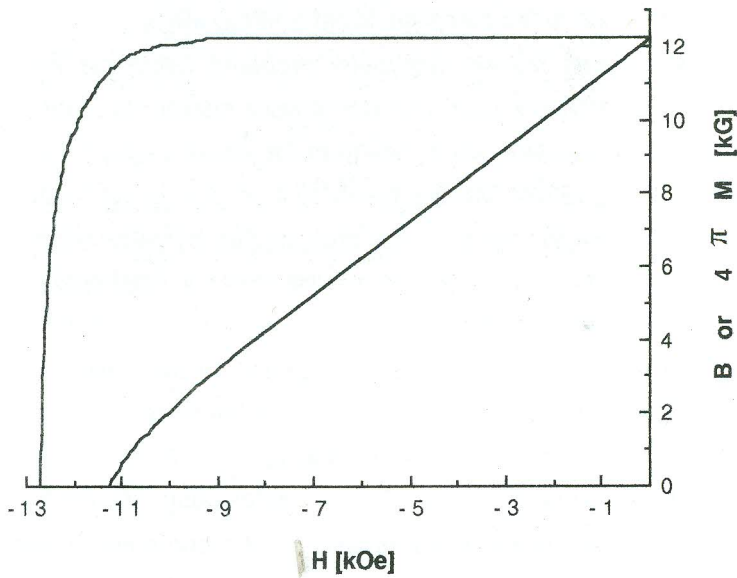


Fig.2 Demagnetization curves for $Nd_{16}Fe_{76}B_8$ HD sintered magnet.