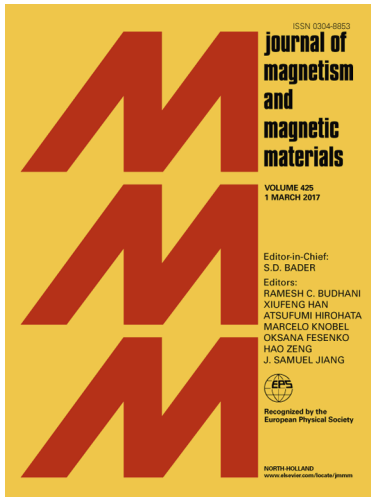

Hot-compaction of $YCo_{4.8}Fe_{0.2}$ nanocrystals for metal-bonded magnets

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Hot-compaction of $YCo_{4.8}Fe_{0.2}$ nanocrystals for metal-bonded magnets

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Highlights

- Dense metal-bonded magnets based on nanocrystalline $YCo_{4.8}Fe_{0.2}$ powder were produced by hot-compaction.
- Higher pressure of 400 MPa gave better mechanical properties over a low pressure procedure.
- Scanning electron microscopy revealed 'core-shell'-type microstructure.
- High-resolution transmission electron microscope revealed the presence of clusters with ~20 nm $YCo_{4.8}Fe_{0.2}$ grains.
- The magnetic properties showed that metal-bonded magnets can compete with ferrites.

Abstract

Metal-bonded magnets based on the nanocrystalline $YCo_{4.8}Fe_{0.2}$ powder were produced by hot-compaction using a spark plasma-sintering device. Zn and Zn/Al metallic binders with a melting temperature close to 420 °C were employed to fabricate dense cylindrical magnets. Two different pressures were used for compaction. The higher pressure of 400 MPa provided a metal-bonded magnet with Vickers hardness (HV10) of 460 ± 20 Vickers units. The temperature coefficients for remanence (α) and coercivity (β) were derived from magnetization measurements in the temperature range 20 °C – 150 °C. α and β for the Zn/Al-bonded magnet pressed with 400 MPa were -0.055 %/°C and -0.201 %/°C. Scanning electron microscopy revealed 'core-shell'-type microstructure. The pure $YCo_{4.8}Fe_{0.2}$ phase was detected in the core region whereas the shell was enriched with non-magnetic Zn or Zn/Al phases. High-resolution transmission electron microscope revealed the presence of ~10 μm clusters with ~20 nm $YCo_{4.8}Fe_{0.2}$ grains. In the Zn/Al-bonded magnet pressed at 400 MPa, the coercivity $\mu_0 H_{ci}$, remanent magnetization σ and energy product $(BH)_{max}$ were 0.87 T, 39.3 Am^2/kg and 23.4 kJ/m^3, respectively.

Key words: Hot-compaction, $YCo_{4.8}Fe_{0.2}$, Metal-bonded magnet, Heavy-rare earth free magnet, Vickers hardness, `core-shell`-type microstructure