

Efek Nano Kristal Fe pada struktur komposit SrFe₁₂O₁₉+alfa-Fe terhadap sifat magnetik melalui metode mechanical alloying = Effect of nanocrystallites Fe in a composite of SrFe₁₂O₁₉+alfa-Fe structures to the magnetic properties by mechanical alloying method

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Abstrak

Barium atau Strontium Hexaferrite (SrFe₁₂O₁₉, SHF) telah digunakan secara luas sebagai magnet permanen karena memiliki sifat kemagnetan yang baik dan stabil secara kimia sehingga memenuhi persyaratan pada berbagai aplikasi. Pada penelitian ini, telah dilakukan rekayasa struktur internal material untuk peningkatan sifat kemagnetan material SHF terutama remanen dan koersifitasnya dengan membuat suatu komposit sistem SHF+(α -Fe). Metode yang digunakan dalam preparasi material SHF adalah metode Mechanical Alloying (MA) yang diikuti oleh perlakuan sintering atau pemanasan pada temperatur tinggi mencapai 1100 oC. Sebelum hadirnya partikel α -Fe, material dengan fasa tunggal SrFe₁₂O₁₉ memperlihatkan loop histeresis magnet permanen dengan magnetisasi remanen sebesar ~0,16 T dan koersifitas ~ 350 kA.m⁻¹. Perlakuan sintering dalam suasana steril terhadap material komposit sistem SHF+(α -Fe) baik itu dengan partikel α -Fe berukuran partikel rata-rata dalam orde mikron maupun nanometer yang diterapkan telah menyebabkan dekomposisi dan oksidasi fasa. Kontak antar partikel penyusun komposit telah memfasilitasi oksidasi fasa Fe oleh kandungan atom oksigen yang terdapat dalam fasa utama. Pembentukan fasa oksida Fe berlangsung relatif mudah disertai dekomposisi fasa kaya atom oksigen menjadi fasa minim oksigen Sr₂Fe₂O₅. Sifat kemagnetan material komposit, yang terdiri dari fasa dekomposisi Sr₂Fe₂O₅ dan oksidasi fasa Fe menjadi FeO dan Fe₃O₄, bersifat magnet lunak.

.....Barium or Strontium Hexaferrite (SrFe₁₂O₁₉, SHF) has been widely used as permanent magnets because it has good magnetic properties and chemically stable which are then suitable for various applications. In the current studies we report our recent findings on improvement of magnetic properties especially remanent magnetization and coercivity of composite SHF+(α -Fe) system. The method used in the preparation of SHF material is mechanical alloying (MA) followed by sintering treatments at high temperatures up to 1100 oC. Before the presence of α -Fe particles which was indicated by a single-phase structure material, SrFe₁₂O₁₉ based sample showed a typical permanent magnet hysteresis loop with remanent magnetization of ~ 0.16 T and the coercivity ~ 350 kA.m⁻¹. Although, sintering treatments have been carried out under sterile atmospheres to the composite magnets, the decomposition of SHF and oxidation of α -Fe were unavoidable. The oxidation occurred in composites with α -Fe particles of average particle size in the order of microns and nanometers. Physical contact between the α -Fe particles and SHF was responsible to the effects. As the sintering treatment was applied to the composite, the contact has facilitated the oxidation of Fe phases together with decomposition of SrFe₁₂O₁₉ phase into Sr₂Fe₂O₅ and thus the internal material was enriched with oxygen. It is concluded that the formation of Fe oxides phase within the composite structure is relatively easy that occurred simultaneously with the formation of reduced SrFe₁₂O₁₉ phase and have lead to the new composite structure consisted of Sr₂Fe₂O₅, FeO and Fe₃O₄. Consequently, the magnetic properties of composite magnets changed from hard to soft.