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

Mochammad Adam Pratama, author

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+(a-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 a-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+(a-Fe) baik itu dengan partikel a-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+(a-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 a-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 a-Fe were unavoidable. The oxidation occurred in composites with a-Fe particles of average particle size in the order of microns and nanometers. Physical contact between the a-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.