Analisa mikrostruktur material magnetik berbasis Nd-Fe-B dan Sm-Co untuk applikasi magnet permanen hibrida

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Abstrak

Telah dilakukan preparasi, kajian dan pengatnatan struktur mikro sampel magnet hibrid SmCO5 - Nd12Fe82B6 setelah melalui proses preparasi teknik metalurgi serbuk. Material hibrid yang dibuat berturut-turut memiliki komposisi stoikiometri yaitu paduan serbuk (Sm,Pr)Co5 (at.%) dan paduan ingot Nd12Fe82B6 (at.%). Unsur Dy disubsitusi kedalam Nd-Fe-B sehingga terbentuk paduan fasa Nd12-xDyx, Fe82B6 (at.%) dengan x = 0, 1, 2, 3, 6 dan 9. Selanjutnya, paduan ingot tersebut diproses mil sehingga dihasilkan serbuk halus (Nd,Dy)-Fe-B dengan ukuran partikel 20-40 pm. Kedua serbuk (Sm-Co dan Nd-Fe-B) dicampur dengan perbandingan berat (80+y);(20-y) (wt%} dengan y = 0, 5, 10 dan 15 dan sebagian campuran tersebut dimil dengan waktu yang bervariasi. Serbuk material tersebut dipadatkan melalui pemadaian satu arab dalam cetakan berbentuk silinder sehingga menghasilkan padatan muda. Sampel yang sangat padat dihasilkan setelah menjalani siklus perlakuan panas.
Telah dihasilkan struktur mikro material hibrid yang terdiri dari fasa hibrid (Pr,Nd,Sm,Dy)2(Fe,Co)14B, (Pr,Nd,Sm,Dy)Co5 setelah tahapan sinter pada temperatur 1150 °C dan anil pada temperatur 850 °C selama 5½ jam dan diikuti pendinginan cepat kedalam air. Juga telah diamati bahwa ?fasa bingkai? mempunyai tipe 1-5 dan 2-14-1 disamping fasa utama 2-14-1 dan 1-5 dalam material hibrid seperti ditunjukkan oleh SEM-EDS, XRF dan XRD. Struktur mikro tersebut sepertinya berpenampilan ?unik? karena berbeda dengan struktur mikro material magnet konvensional yang berbasiskan Nd-Fe-B atau Sm-Co. Studi dengan SQUID juga dilakukan untuk mengevaluasi sifat magnetik meskipun histerisis loop yang dihasilkan hanya terdapat pada kwadran pertama. Kesimpulan dari penelitian ini adalah bahwa hibridisasi dua fasa magnetik permanen yang berbeda telah memberikan informasi baru yaitu telah dihasilkannya struktur mikro yang ?unik? walaupun fasa-fasa magnetik 1-5 dan 2-14-1 masih tetap dipertahankan sebagai fasa-fasa utama dalam material material hibrid.
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The preparation, investigation and observation of microstructure of the SmCo5 - Nd12Fe82B6 hybride magnetics sample which after preparation processing by powder metallurgy technique have been done. Hybride materials were made of stoichiometry (Sm,Pr)Co5 (at%) and Nd12Fe82B6 (at.%) compositions respectively in form of powders and lumps. The element of Dy was substituted into Nd-Fe-B to produces Nd12-x Dyx, Fe82B6 (at%) alloys with x = 0, 1, 2, 3, 6 and 9. The alloys were further ball milled to produce fine powders of (Nd,Dy)-Fe-B in the size range of 20-40 μm. Both kinds of powders (Sm-Co and Nd-Fe-B base) were then mixed with ratio (80+y):(20-y) in weight for y = 0, 5, 10 and 15 and successively milled with various milling times. The powder materials were compacted in a silindrieal die and pressed in one direction leads to green compacts. Fully dense compacting samples were obtained after the application of designed heat treatments.
It was found that microstructure for hybrid materials consisted of (Pr,Nd,Sm;Dy)2(Fe,Co)14B, (Pr,Nd,Sm,Dy)Co5 obtained after a sintering step at temperature 1150 °C and annealed ata temperature of

850 °C for 5½ hours and followed by quenching into water. It was also observed that a ?frame phase? of 1-5 and 2-14-1 types in addition to the main phase of 2-14-1 and l-5 in hybride materials as shown by SEM-EDS, XRF and XRD. This kind of microstructure is assumed unique because different with conventional microstructure of sintered Nd-Fe-B or Sm-Co based materials. The study also employed SQUID to evaluate the magnetic properties despite only first quadrant of the hysteresis loop which available. The conclusion of the current study is that hybridization of two different hard magnetic phases have given new information in that it has produced ?unique? microstructures while the magnetic phases of 1-5 and 2-14-1 still remain as tl1e main phases in hybride materials.