

MAGNETIC AND ELECTROMAGNETIC CHARACTERIZATION
OF
BARIUM HEXAFERRITE CERAMICS AND THEIR POLYMER MATRIX
COMPOSITES

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ABSTRACT

MAGNETIC AND ELECTROMAGNETIC CHARACTERIZATION OF BARIUM HEXAFERRITE CERAMICS AND THEIR POLYMER MATRIX COMPOSITES

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In this study, BaHF-based polymer matrix composites were prepared as potential EM wave absorbing materials. Firstly, BaHF powders and platelets were synthesized by mixed oxide method and by molten salt synthesis (MSS) technique, respectively, which were further used as additives in the EM wave absorbing composites. The effect of molten salt composition on the amount of BaHF phase formation, as well as, on the morphology and magnetic properties of the final products were discussed according to the characterization results. Quantitative XRD results showed that with the increase in NaCl flux content, BaHF formation was enhanced and the highest conversion (97.8 wt%) was obtained in the case of 100 wt% NaCl flux. Corners of the BaHF platelets in NaCl flux were rounded, while KCl flux produced sharp edge platelets. Increasing NaCl content in the flux improved the coercivity and remnant magnetization of BaHF, leading to a more pronounced hard magnetic behavior.

In the second part of the study, BaHF-based polymer matrix composites were prepared by tape casting method, and their electromagnetic wave absorption potentials were investigated within 18-40 GHz frequency range by free-space measurement method. Effect of BaHF content and alignment on the EM wave properties was investigated. To enhance the EM wave absorption potential of the resulting composites, graphite or nickel flakes were incorporated into polymer matrix, and multilayered composites were produced. BaHF-Ni flake containing composites revealed ~50-75% EM wave absorption in 18-40 GHz range with the synergistic effect of the magnetic and ohmic loss effective in the structure.

Keywords: Barium Hexaferrite Ceramics, Mixed Oxide Method, Molten Salt Synthesis, Electromagnetic Wave Absorption, Polymer Matrix Composites.

ÖZ

BARYUM HEKZAFERRİT SERAMİKLERİNİN VE BARYUM HEKZAFERRİT POLİMER MATRİS KOMPOZİTLERİNİN MANYETİK VE ELEKTROMANYETİK KARAKTERİZASYONU

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Bu çalışmada, EM dalga absorplama performansı için BaHF polimer matrisli kompozitler üretilmiştir. İlk olarak, BaHF tozu ve plakaları sırasıyla karışık oksit yöntemi ve eriyik tuz yöntemi ile üretilmiş ve sonrasında ise, elektromanyetik dalga sönümleyen kompozitlerde kullanılmıştır. Karakterizasyon sonuçlarından elde edilen veriler doğrultusunda, eriyik tuz kompozisyonunun oluşan BaHF'nin faz miktarına aynı zamanda da, morfoloji ve manyetik özelliklerine olan etkileri tartışılmıştır. Niceliksel X-Işınları Kırınımı sonuçları, NaCl tuz miktarının artışı ile BaHF faz oluşumunun arttığını ve en yüksek dönüşümün (ağırlıkça % 97.8) ağırlıkça % 100 NaCl tuzunda elde edildiğini göstermiştir. NaCl tuzunda, BaHF plakalarının köşeleri yuvarlak iken, KCl tuzu, keskin köşeli plakalar oluşturmuştur. Eriyik içerisindeki NaCl miktarının artışı, BaHF'nin koersivite ve remanent manyetizasyonunu iyileştirir, daha kalıcı manyetik özelliklerin oluşumunu sağlamıştır.

Çalışmanın ikinci kısmında, şerit döküm yöntemi ile BaHF-polimer matrisli kompozitleri üretilmiştir ve serbest uzay yöntemi ile 18-40 GHz frekans aralığında elektromanyetik dalga sönümlenme performansları ölçülmüştür. BaHF faz miktarının ve yönlenmesinin elektromanyetik dalga etkileşim özelliklerine etkileri incelenmiştir. Kompozitlerin elektromanyetik dalga sönümlenme özelliklerini iyileştirmek amacıyla, polimer matrisi içerisine grafit ve nikel plakalar eklenmiş ve çok katmanlı kompozitler oluşturulmuştur. BaHF/Nikel içeren polimer matris kompozitleri, yapıdaki manyetik ve ohmik kayıpların etkisi ile 18-40 GHz frekans aralığında yaklaşık olarak 50-75 % EM dalga absorplama özelliği göstermiştir.

Anahtar Kelimeler: Baryum Hekzaferrit, Karışık Oksit Yöntemi, Eriyik Tuz Sentezi, Elektromanyetik Dalga Sönümlenme, Polimer Matris Kompozitler

To My Family,

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