

Composition and magnetic properties of aluminium substituted yttrium iron garnet waste mill scales derived via mechanical alloying technique

ABSTRACT

This paper presents the effects of aluminium substitution on sample composition, density and magnetic properties of yttrium iron garnet, $Y_3Fe_5O_{12}$ (YIG). Mill scales, in a form of flakes was obtained from the steel industry in Malaysia. The mill scales was purified to produce high purity hematite, Fe_2O_3 . The mill scales derived Fe_2O_3 were used as raw material to prepare the aluminum substituted yttrium iron garnet $Y_3Fe_{(5-x)}Al_xO_{12}$ (Al-YIG) with variation compositional $x = 0.0, 0.5, 1.0, 1.5$ and 2.0 using mechanical alloying technique. X-ray fluorescence (XRF) was used to investigate the percentage compositions of the raw mill scales. The magnetic hysteresis of sample were investigate by using B-H tracer (MATS). Density of the Al-YIG bulk samples was found to decrease with increasing xAl_2O_3 content. The saturation magnetization M_s also shows a decrease with increase xAl_2O_3 content. The maximum saturation magnetization M_s and coercivity H_c was found at 310 G and 14.98 Oe, respectively. With increase xAl_2O_3 to 2.0% , the M_s and H_c were reduced to 29.35 G and 3.15 Oe, respectively.

Keyword: Aluminium substitution; $Y_3Fe_{5-x}Al_xO_{12}$; Mechanical alloying technique