

## **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