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The use of mechanochemical processing in preparation of ultrafine Bi-substituted Yttrium Iron Garnet (Bi-YIG)

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Abstract: In this work we have prepared nano-sized Bi-YIG powders, using mechanochemical processing. In this process, a part of the activation energy, which is necessary for chemical reactions, is provided by high-energy mills. The as milled powders obtained by this technique need a lower annealing temperature in comparison with those obtained by conventional ceramic technique to become a single phase garnet. The lower temperature itself can produce ultrafine powders by inhibiting grain growth. The optimum calcining temperature was 800 ^{o}C for 5 hours milling time, which is much lower than 1000^{o}C needed in conventional ceramic technique. Longer milling times are not recommended, because it produces extra iron into the powders. The average particle size of the powders was in the range 50 to 60 nm, using Scherrer's formula. Room temperature saturation magnetizations of the samples were measured using a vibrating sample magnetometer (VSM). These were 0.022, 6, 17 and 20 emu/g for the samples annealed at 700, 725, 750 and 800 ^{o}C, respectively. The lower magnetization values respect to the conventional ceramic technique, are discussed according to core-shell model.

Keywords: *Mechanochemical processing, Nanoparticles, Substituted garnets, Calcining temperature, Saturation Magnetization*