Simple preparation and characterization of bismuth ferrites nanoparticles by thermal treatment method

ABSTRACT

In the present work, nanoparticles of multiferroic bismuth ferrites ($BiFeO_3$) were synthesized via a simple thermal treatment method. $BiFeO_3$ was prepared from an aqueous solution containing bismuth nitrate and iron nitrate as starting materials, polyvinyl pyrrolidone (PVP) as a capping agent and nitric acid to dissolve the bismuth nitrate, respectively. It is followed by thermal treatment at various calcination temperatures at 350, 450 and 550 °C. The samples were characterized by thermogravimetric analysis, X-ray diffractometer (XRD), transmission electron microscope (TEM), vibrating sample magnetometer and electron spin resonance (ESR) spectroscopy. XRD results indicate that the samples, calcined at 350, 450 and 550 °C, crystalized in rhombohedral crystal structure (space group R3c). The crystallinity of samples increased with increasing calcination temperature. Morphology study using TEM confirmed the growth of $BiFeO_3$ nanoparticles with the average particle's size increases from ~30 nm up to ~80 nm with the increasing of calcination temperature from 350 to 550 °C. Magnetic saturation M_s, of samples decreased from 2.15 to 0.25 emu/g while the coercivity H_c, increased from 54.41 to 272 G when the calcination temperature increased from 350 to 550 °C. ESR revealed increment of g-factor value from 2.14 to 2.64 and peak-to-peak linewidth from 129.33 to 201.61 Oe with the increasing of calcination temperature from 350 to 550 °C. The results demonstrate that by using thermal treatment method, the $BiFeO_3$ nanoparticles can be obtained at low temperature, i.e. 350 °C.

Keyword: Bismuth ferrites nanoparticles; Nanoparticles of multiferroic bismuth ferrites (BiFeO3); Polyvinyl pyrrolidone (PVP); X-ray diffractometer (XRD); transmission electron microscope (TEM)