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Fabrication and Characterization of Electrospun NiZn Ferrite Nanofiber

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The ceramic nanofibers have great potential to fabricate and exhibit both large surface area and specific nanostructures, which tend to be mutually exclusive. Recently, it is investigated that some of electronic ceramic nanofibers can be produced by electrospinning with high surface area-to-volume ratio which can also be found to be unique in producing continuous nanofibers[1]. Among those applications of electronic ceramics, the preparation of magnetic iron oxide nanofibers have been reported in various potential applications as storage devices, catalyst, drug carrier[2,3].

Generally, ceramic nanofibers are made by the electrospinning of ceramic precursors in the presence of polymer followed by calcinations at higher temperatures. However, it is available to obtain the good crystallinity with a relatively low calcination temperature. The spinel ferrite MFe_2O_4(M=Ni, Zn) nanofibers were synthesized by a electrospinnng process in this study. The raw materials as chemical reagents were iron(III) chloride, nickel(II) acetate tetrahydrate and zinc acetate dihydrate. The aqueous metal salts/polymer solution was prepared with polyvinyl pyrrolidone in N,N-dimethylformamide and metal salts under stirring at room temperature. The applied electric field and spurting rate for spinning conditions were 10kV, 2mℓ/h, respectively. The obtained fibers were calcined to 600^{o}C for 3h and sintered at 900~1,200^{o}C in air. By tuning the viscosity of batch solution before electrospinning, we were able to control the microstructure of NiZn ferrite fiber in the range of 70~200nm at 770 cp. The primary particle size in a ferrite fiber was about 10~15nm. The typical grain growth in each NiZn ferrite nanofiber was observed and showed the ferromagnetic hysteresis behavior. The multipod growth was also observed as a nanorod-shaped which was obtained with heat treatment condition after electrospinning.

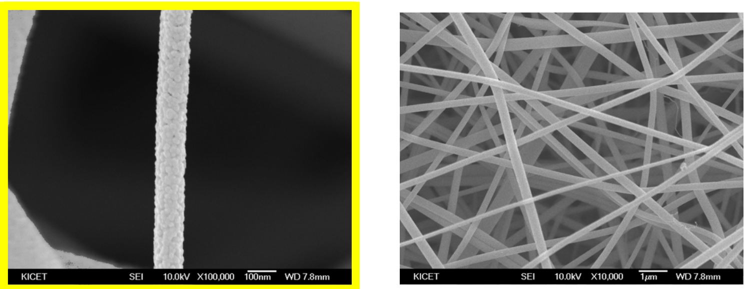

Fig. 1. Scanning electron micrograph of NiZn ferrite nanofiber prepared by electrospinning method.

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Preparation and Properties of Multiferroic Bismuth Iron Oxides

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The rhombohedrally distorted perovskite-type multiferroic ceramics have attracted considerable research interest due to their coupled properties of ferroelectricity, ferromagnetism or antiferromagnetism, ferroelasticity with a relatively high Néel temperature(~380ºC) and high Curie temperature(~810ºC). These materials have good prospects for use in magnetoelectric devices and sensors where both polarization and magnetization can be coupled. Among the materials being most widely investigated, $BiFeO_3$ has some very attractive features as those properties coupling between ferroelectric polarization and magnetization [1-4].

The variation of bismuth iron oxide compositions were investigated and cationic substitutions in the structure of $BiFeO_3$ compounds. Those multiferroic bismuth iron oxides were synthesized by conventional ceramic processing and studied through X-ray diffractometry, scanning electron microscopy, thermal anlaysis, electrometry and magnetometry. The apparent density of sintered Bi-Fe-O ceramics was increased with composition and showed the higher value in the Fe-deficient region. In general, $BiFeO_3$ presents the anitiferromagnetism at room temperature with narrow single phase region, but has studied as a possible active material of Pb-free ferroelectric materials. The magnetic behavior of those bismuth iron oxides was affected by processing parameters and some of cationic substitutions. In addition, we have also shown the enhanced magnetic properties La substitution, yet preserving the ferroelectric and antiferromagnetic characteristics of the processed powders.

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