$BiFeO_3$ thin film morphology study considering drying and dewetting

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Manufacturing of sensors and detectors using active thin films aiming applications in biology, agriculture, environmental control and medicine has been developed in the last decades. Among the manufacturing processes, the dip coating technique is one of the cheapest. When the interest is manufacturing of ultra thin films, thickness less than 100nm, the nano structure of these films suffer a strong influence of the substrate and the mechanisms of drying and dewetting. We will discuss here the influence of these mechanisms in a Bismuth ferrite film deposited over glass. $BiFeO_3$ resin were obtained by the polymeric precursor method. The precursor materials used were the Bismuth II nitrate ($Bi(NO_3)_3.5H_2O$, 98%, Alfa Aesar), Iron sulfate ($FeSO_4.7H_2O$, 99%, Alfa Aesar). The cationic precursors were mixing to the citric acid (CA) previously dissolved in distilled water at the molar ratio for metals (M) was 3:1. The resultant solutions were stirred and heated until the complete dissolution of the cations (at 70-80 ºC). Following this dissolution, the solutions were mixed with ethylene glycol (RG), at the mass ratio of CA:EG = 60:40, in order to promote the citrate polymerization by polyesterification reaction, increasing the temperature to 120 ºC. The $BiFeO_3$ resin presents yellow color and transparent. Films were carried out by dip coating process. AFM shows different film regions whose morphology is related to the drying and dewetting process. AFM shows that the substrate was completely covered by a homogeneous thin film layer, showing a uniform drying process at these regions (fig 1.a, 1.b) and adhesion of the film to the substrate. Analyzing other regions it is noted the existence of aggregates, with the shape of islands (fig 1.c) over the first layer deposited. At these regions particles loose correlation with the substrate and the cohesion forces surpass adhesion to the substrate. A third kind of morphology (fig 1.d) appears like thick steps, about 100nm, showing that the dewetting process made a second layer over the first one already adhered over the substrate.

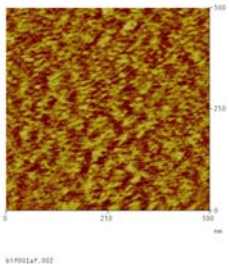

Figure 1.a (500nm)

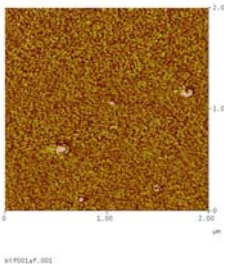

Figure 1.b (2μm)

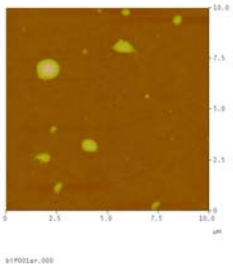

Figure 1.c (10μm)

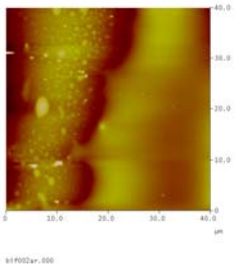

Figure 1.d (40μm)

Keywords: dewetting, drying, Bismuth ferrite, thin film
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[1] Self-organization of triblock copolymer patterns obtained by drying and dewetting , Carvalho, AJF; Pereira-Da-Silva, MA; Faria, RM, EUROPEAN PHYSICAL JOURNAL Vol. 20 Iss. 3 Pg. 309-315, 2006

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