CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

Magnesium-doped barium strontium titanate powders were successfully prepared by low-temperature sol-gel method with various mole ratio of strontium and magnesium. During calcination process, the proper crystallization temperature was found to be higher than 900℃. The obtained perovskite structure of magnesium – doped barium strontium titanate showed the reduction of tetragonality as a function of magnesium ions, which the tetragonal structure have been transformed to cubic structure. The quantitative analysis also supported the investigation that the increasing amount of magnesium titanate phase were occured as the magnesium dopant increases. The substitution of magnesium-ions in A-site of ABO_3 perovskite structure affected to the reduction of dielectric constant of magnesium-doped barium strontium titanate powders. Moreover, the frequency-dependent and temperature-dependent dielectric properties were functions of strontium and magnesium content. However, the loss tangents of magnesium-doped barium strontium titanate were not exceed 0.03 and had tendency to decrease with increasing amount of magnesium content.

The poly(butylene succinate) composite thin films incorporated with barium strontium titanate powder were prepared by solution mixing and compression molding. The dispersion state showed the agglomerate formation increased as increasing amount of BST content. The mechanical properties results showed the reduction of tensile strength and elongation at break as a function of volume fraction of BST powder. With increasing amount of BST powder, the PBS composite thin film became more brittle. On the other hand, the PBS composite thin film showed the improvement of dielectric properties as BST powder content increase. It is the fact that high dielectric constant barium strontium titanate filler have ability to generate polarization more desirable than that of low constant poly(butylene succinate) matrix. As well as the dispersion of BST powder was found to be random in PBS matrix according to 0-3 connectivity. Therefore, the value of dielectric constant of PBS-composite thin films were lower than those of BST powder due to the fact that BST particles were not closely packed. The overall dielectric constant of PBS composite as a function of BST powder volume fraction were consistent with 0-3 connectivity model called modified-Lichtenecker model, where fitting parameter (n) was equal to 0.28. The fitting parameter was closed to the value of 0.3 which was said to be the possession of well-dispersed system. The author has attempted to improve the dispersion state, mechanical properties and dielectric properties by using surface treatment agent on surface of BST powder. The result did not show any improvement of those properties. The SEM image in Figure 6.1 was the primary example of the result in the effect of surface treatment of BST powder in PBS composite thin film which were shown in appendix F. The result in SEM image still shown the agglomeration of BST powder in PBS composite. In addition, the voids were formed in propylene glycol treated BST/PBS composite during application of heat in compression molding process.

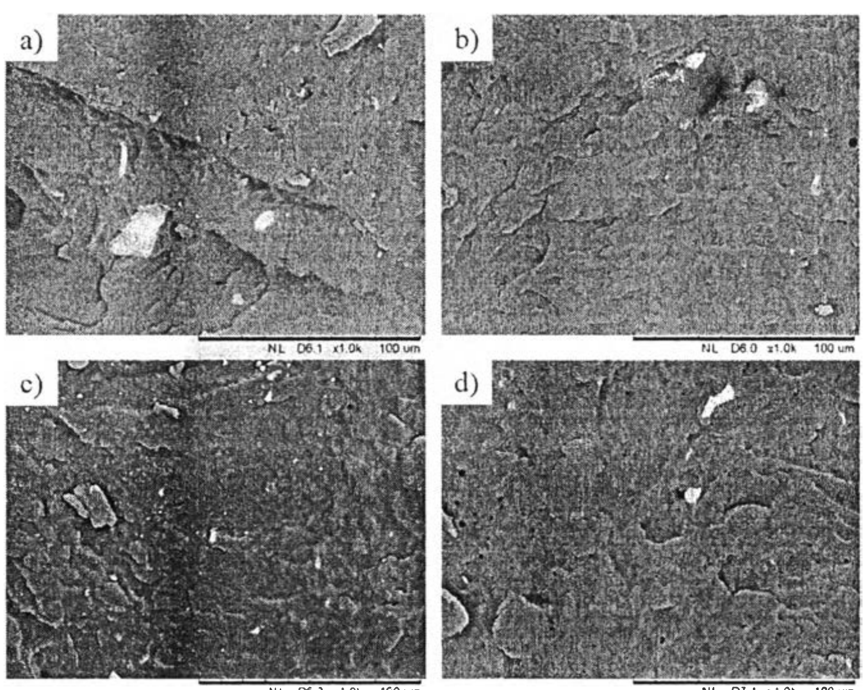

Figure 6.1 SEM image of surface treated BST/PBS composite a) non-treated b) Triethoxyvinyl silane-treated c) Ethylene glycol-treated and d) Propylene glycol-treated.

Recommendations

1. In order to be able to suppress the higher amount of loss tangent in magnesium-doped barium strontium titanate, the mole fraction of magnesium dopant should be at higher content than 3.5 mol%. If magnesium content exceeded 10 mol%, the secondary phase such as MgO would occur in the XRD pattern.

2. The preparation of surface treated BST/PBS composite thin film should be done by using thermal mixing method such as extrusion molding in order to maintain the surface treatment agent on the BST surface. Because during the solution mixing process by using chloroform as a solvent, the solvent washed out the surface treatment agent so that the surface treatment did not have effect to the properties of BST/PBS composite thin film and obtain the well dispersed filler phase.

3. To study the dielectric properties of magnesium-doped barium strontium titanate compacted powder and PBS composite thin film, the dielectric specimens should be coated with platinum coated in order to obtain accurately measurement with low loss tangent.

4. The glass transition temperature of PBS-composite should be measured by using Dynamic Mechanical Analysis (DMA).