Chapter 5

Conclusions

1. The optimum average particle size and particle size distribution of Pb-based ferroelectric powders (ACL 4040, ACL 4050, and ACL 4055) were 1.0 - 1.5 μm and 0.3 - 4.0 μm, respectively for using in paste compositions because of their high solid loading.
2. The ferroelectric thick films prepared from as-received powders (ACL 4040 and ACL 4055) of which the average particle size was about 4.0 – 5.0 μm gave the highest dielectric constant (APA=53.6 and UPA=81.5 at 1 kHz frequency) because of the small amount of abnormal grains (second phases) present.
3. The ethyl cellulose binder affects the rheology of the ferroelectric pastes as it gave rise to high viscosity of the paste. In this research, the optimum organic vehicle was TE4 and it was composed of 5.04 wt% ethyl cellulose and 94.96 wt% terpineol.
4. The phosphate ester dispersant improved the homogeneity of screen-printed thick films and also increased the solid concentration. Therefore, the dielectric constant of the film containing phosphate ester was high.
5. The frit ($PbO.B_2O_3.Bi_2O_3$) could slightly increase densification of the thick film which results in the higher dielectric constant.
6. The optimum sintering temperature for UPB8EF1 thick film was 750°C for 1 hour. The average dielectric constant and dissipation factor of this film at 1 kHz frequency were 351.6 and 0.15, respectively. This dielectric constant is rather high when it is compared with a previous study (K=110).
7. The reaction between the stainless steel substrates and the ferroelectric thick films resulted in abnormal grains (second phases) and an oxide layer. These problems cause a decrease in dielectric constants.