

**The Government of the Union of Myanmar  
Ministry of Education**

**Department of Higher Education (Lower Myanmar)  
and  
Department of Higher Education (Upper Myanmar)**

**Universities  
Research Journal**

# Universities Research Journal 2008

## Vol. 1, No. 3

### Editorial Board

#### **Editors in Chief**

Prof. Dr. Saw Hla Myint, Head of the Department of Chemistry, University of Yangon

Prof. Dr. Thein Thein Win, Head of the Department of Chemistry, Yangon Institute of Education

Prof. Dr. Thida Win, Department of Chemistry, University of Mandalay

Prof. Dr. Win Win Thar, Head of the Department of Physics, University of Yangon

Dr. Khin Tint, Associate Professor, Head of the Department of Physics, Yangon Institute of Education

Prof. Dr. Yin Mya, Head of the Department of Physics, University of Mandalay

Prof. Daw Nwe Nwe Win, Head of the Department of Computer Studies, University of Yangon

#### **Editors**

Prof. Tin Kyaing, Head of the Department of Chemistry, Yangon University of Distance Education

Prof. Khin Khin Saw, Head of the Department of Chemistry, University of Dagon

Prof. Dr. Aye Aye Tun, Head of the Department of Chemistry, University of Sittway

Prof. Dr. Tin Tin, Head of the Department of Chemistry, University of Pyay

Prof. Dr. Daw Hla Than, Head of the Department of Chemistry, University of Dawei

Prof. Dr Phway Phway, Head of the Department of Chemistry, University of East Yangon

Prof. Dr. Khin Myo Nwe, Head of the Department of Chemistry, University of Hinthada

Prof. Dr. Myint Myint Sein, Head of the Department of Chemistry, University of Mandalay

Prof. Dr. Aye Aye Wai, Head of the Department of Chemistry, University of Magway

Prof. Khin Hnin Lwin, Head of the Department of Chemistry, University of Monywa

Prof . Dr. Sein Sein Aung, Department of Chemistry, University of Panglong

Prof. Dr. Tha Zin, Head of Chemistry Department, University of Loikaw

Prof. San San Wai, Head of the Department of Chemistry, University of Lashio

Prof. Dr. Aye Myatt Mynn, Head of the Department of Physics, University of Mawlamyine

Prof. Dr. Than Hla, Head of the Department of Physics, Yangon University of Distance Education

Prof. Dr. Khin Mar Kyu, Head of the Department of Physics, University of Dagon

Prof. Dr. Thet Tun Aung, Head of the Department of Physics, University of Patheingyi

Prof. Dr. Daw Thein Win, Head of the Department of Physics, University of Sittway

Prof. Dr. Khin Soe Win, Head of the Department of Physics, University of Pyaw

Prof. Dr. Myint Myint Moe, Head of the Department of Physics, University of Dawei

Associate Prof. Dr Ni Ni Zin, Head of the Department of Physics, University of East Yangon

Prof. Dr Tin Tin Win, Head of Department of Physics, University of West Yangon

Prof. Dr. Mya Mya Win, Head of the Department of Physics, University of Hinthada

Prof. Myint Yee, Head of the Department of Physics, University of Maubin

Prof. Dr. Myint Myint Tun, Head of the Department of Physics, University of Hpaan

Prof. Dr. Than Win, Head of the Department of Physics, University of Myeik

Prof. Swe Swe Yi, Head of the Department of Physics, University of Monywa

Prof. Dr. Thet Thet, Head of the Department of Physics, Mandalay University of Distance Education

Prof. Dr. May Yee Thein, Head of Physics Department, University of Panglong

Prof. Dr. Soe Soe Nwe, Head of the Department of Physics, University of Lashio

Prof. Dr. Khin May Oo, Head of Department of Physics, Myinchan Degree College

## Contents

	<b>Page</b>
Determination of Calorie Contents of Myanmar Snacks from Thanlyin Township <i>Nyo Nyo Aung, Mya Mya Mu and Myat Sandar Hla</i>	1
Analysis of the Carbonate in Limestone from Loikaw Area <i>Tha Zin, Than Than Myint and Ni Ni Sein</i>	19
Preparation and Application of Intercalated Zinc Oxide Carbon Molecular Sieves <i>Mya Thuzar, Nyunt Wynn and Khin Mar Tun</i>	31
Process Development of Lentil flour- based Adhesive for Woodworking Industries <i>Tin Sein</i>	39
Isolation, Identification and Antibacterial Activity of Some Xanthones Present in Fruit Hulls of <i>Garcinia Mangostana</i> Linn. <i>Sandar Aung, Aye Aye Tun, San San Aye, and Maung Maung Htay</i>	47
Studies on an Unknown Compound from <i>Argyreia barbigera</i> Choisy <i>Htay Htay Win</i>	57
An Antioxidant Organic Compound Isolated from the Stem of <i>Hypericum calycinum</i> L. (Pyin-nyar-lin-kar) <i>Thida Win, Thant Thant Htwe, Myint Myint Sein and Joerg Heilmann</i>	71
Repellent Action of Citronella Oil Against <i>Aedes Aegypti</i> Mosquito <i>Ei Ei Soe</i>	81
Investigation of the Antioxidant Activity of <i>Cydonia cathayensis</i> Hemsl. (Chinsaw-ga) Fruit <i>San San Oo</i>	95
Isolation and Structural Elucidation of an Unknown Biologically Active Compound from Myanmar Traditional Indigenous Medicinal Plant <i>Clerodendrum serratum</i> SPRENG (Yin-bya-net) <i>Aye Myint, Myint Myint Sein and Mya Aye</i>	105

	<b>Page</b>
Anti- <i>Helicobacter pylori</i> and Anti-tumor Activities of (Korea and Myanmar) Herbal Medicines <i>Hnin Hnin Aye</i>	119
Structural Elucidation of a Bioactive Carbazole Compound Isolated from <i>Pteris pellucida</i> Presl. (Say-ba-zun-doke) <i>Lwin Lwin Myint</i>	129
Thermodynamic Investigation of Dodecylpyridinium Ion Binding with Fulvic and Humic Acids <i>Min Min Yee, Tohru Miyajima and Noboru Takisawa</i>	141
Detecting the Incoming Objects by Using Infrared Radiation <i>Moe Nyo, Than Tun Oo and Aye Maw Aung</i>	151
High Performance Computing in Yangon University <i>Pho Kaung and Ye Chan</i>	161
Peripheral Interface Controller - Based Frequency Meter <i>Htar Htar Aye Win, Thida Soe and Ni Ni Yin</i>	167
Spectral Analysis on Voices of Myanmar Characters and Words <i>Ye Chan and Win Win Kyi</i>	177
Polarization Phenomena Associate with Scattering of Radiation in Astrophysics <i>Yee Yee Oo, G. Padmanabha and G. Ramachandran</i>	187
The Study of the Curves of Functions for Data Points <i>Hla Myint Kyaw</i>	203
Analysis of a Double- $\square$ Hypernucleus Event in the KEK-PS E373 Experiment <i>Khin Than Tint</i>	217
Elemental Analysis of Tawkyetthun (Herbal Plant) for Treatment of Diabetes <i>Khin Tint</i>	227
Production of Kaonic Nuclei $K^-pp$ by $p(p, K^+)$ and $p(d, K^0)$ Reactions <i>Htar Win Htike, Mar Mar Htay and Khin Swe Myint</i>	235

	<b>Page</b>
<b>Study on the Number of Alpha Tracks and Pore Diameters Based on Annealing Method</b> <i>Mya Mya Win</i>	247
<b>Charge Storage Mechanism of PbTi<sub>0.99</sub>Al<sub>0.01</sub>O<sub>3</sub> Gated Short – Channel Thin Film Transistor</b> <i>Khin Nyo Win, Kyi Kyi Aung and Lai Lai Aung</i>	259
<b>Effects of Overgrowth, Growth Rate, and Capping of InAs Quantum Dots Grown on Cross-hatch Surfaces by Molecular Beam Epitaxy</b> <i>Cho Cho Thet, Ko Ko Kyaw Soe, Teeravat Limwongse, Somsak Panyakeow and Songphol Kanjanachuchai</i>	269
<b>Electrical Properties of Zn<sub>1-x</sub>Cu<sub>x</sub>O/Si Thin Film</b> <i>Min Maung Maung and Aye Myat Minn</i>	277
<b>Growth and Characterization of Indium doped Zinc Oxide Solar Cell</b> <i>Yee Yee Oo, Aye Aye Swe and Than Than Win</i>	285
<b>Growth Mechanism, XRD, Raman and FTIR Spectroscopic Studies of Potassium Pentaborate (KB5) Crystal</b> <i>Zin Min Tun and Win Kyaw</i>	293
<b>Growth of Sol-Gel Derived Lead Titanate Thin Film for Non-Volatile Memory Device Application</b> <i>Khin Moe Thant and Yin Maung Maung</i>	303
<b>Ionic Conductivity and Dehydration of ZnSO<sub>4</sub>.7H<sub>2</sub>O Crystal at High Temperature</b> <i>Wut Hmon Win</i>	313
<b>Ionic Conductivity of xM<sub>2</sub>O . (1-x) B<sub>2</sub>O<sub>3</sub> Glass</b> <i>Soe Soe Thin</i>	325
<b>Study on Ferroelectric Properties of TiO<sub>2</sub> / SiO<sub>2</sub> /p-Si (Metal/ Ferroelectric/ Insulator/Semiconductor) Thin Films</b> <i>May Yee Thein, Yin Yin Thein, Than Than Win and Ko Ko Kyaw Soe</i>	335
<b>Multi-Agent Architecture Approach to Web-Based Teaching System</b> <i>Nwe Nwe Win</i>	345
<b>Optimizing Database Queries by Indexing</b> <i>Soe Mya Mya Aye</i>	355

## **Growth of Sol-Gel Derived Lead Titanate Thin Film for Non-Volatile Memory Device Application**

**Khin Moe Thant<sup>1</sup> and Yin Maung Maung<sup>1</sup>**

### **Abstract**

Sol-gel derived lead titanate transparent sol is firstly prepared from lead acetate trihydrate and titanium isopropoxide as starting materials. It is refluxed with Oil-bath at 110°C for 6 h and lead titanate sol-gel is formed. Dynamic viscosity measurement is carried out by viscometer. The precursor sol is deposited on defect-free and highly polished p-Si substrate by local-made spin –coating machine. Scanning Electron Microscopy (SEM) analysis is carried out to examine the microstructural properties of fabricated film. Before the contact process, front and counter metallizations are done. 100 kHz C-V characteristics is observed by LCR meter (Digital Impedance Analyzer: Quch Tech: 1730) and gives the memory function. 100 kHz P-E hysteresis loop is also measured by Sawyer – Tower circuit. Hysteresis parameters such as spontaneous polarization density, remanent polarization density and coercive field are evaluated.

**Key words:** C-V characteristics, P-E hysteresis loop, SEM analysis.

### **Introduction**

In recent years, ferroelectric materials have become very interesting materials for use in nonvolatile random access memory (NVRAM) (Hirotaka, 2005). Ferroelectric materials have attracted much attention for applications to ferroelectric random-access memories and microelectromechanical systems because of their excellent pyro-, piezo- and ferroelectric properties (Mamoru, 2005).

Ferroelectricity describes a collection of phenomena which contribute to the generation of a spontaneous electric polarization in materials called ferroelectrics. Spontaneous polarization is a result of the materials having a unique polar axis. The important point is that the direction of the spontaneous polarization can be switched by an external electric field (Matthew, 2001). The control of bistable polarization states in ferroelectric perovskite oxides by applying an electric field is the underlying basis of their applications to nonvolatile memories, piezoelectric devices and uncooled infrared detectors (Yuji, 2005).

---

1. Assistant Lecturer, Department of Physics, University of Yangon



## Experimental Procedure

The first step of this work was the mixing and stirring of lead acetate trihydrate (4.93 g) and ethylene glycol solvent (1.55 ml) by magnetic stirrer with constant speed (500 rpm) for 4 h. Next, the titanium isopropoxide (2.5 ml) and triethanolamine (TEA) (4 ml) were mixed and stirred by magnetic stirrer for 4 h in N<sub>2</sub>-atm of glove-box. It was relaxed at 110 °C for 2 h in Oil-bath. After cooling, yellow liquid was significantly formed. After that resulting two sols were mixed to form the complete mixture. The above product sols were poured into 3-neck flask and refluxed at 110 °C for 6 h. Finally, lead titanate sol was formed. Dynamic viscosity was measured to be 65cP. The sol-gel was deposited onto cleaned p-Si (100) substrate by local-made spin-coating machine. The rotational speed was set 800 rpm and spinning time was 120 s. The substrate temperature was 400 °C. Managements of process temperatures were 500 °C, 550 °C, 600 °C, 650 °C and 700 °C maintained 1 h. Thus lead titanate film was formed. The film thickness was calculated to be 4.68 μm and it was found to be within the range of accepted value for thin film.

## Results and Discussion

The PbTiO<sub>3</sub> (PT) thin films were thus obtained on p-Si substrates at different process temperatures. As the material evaluation, PT film was examined by SEM. Fig.1 (a~e) represented the SEM photo-graphs of the films at 500 °C, 550 °C, 600°C, 650 °C and 700 °C. Moreover, the images became rough after it was treated at 650 °C and 700 °C in contrast to the smooth the film treated at 500 °C, 550 °C, and 600 °C. The orientation of each film was almost the same and related to the substrate orientation. All films looked little dense except the film at 500 °C. Memory effect of C-V characteristic was measured to study whether the ferroelectric films could control the p-Si substrate. 100 kHz C-V characteristics of PT films were measured by LCR meter (Digital Impedance Analyzer) and described at Fig. 2 (a~e). From the figure, it was clearly observed that three distinct regions were formed. Moreover, it was found that the capacitance value went steadily in inversion state, gradually increased through the depletion region and almost reached its saturated value in accumulation region. Process temperature dependence of the memory window for PT film was given as Fig. 3 (a). As it was seen in figure, it was significant that memory window was gradually increased with increasing process temperature. The change in threshold voltage with respect to process temperature was shown

in Fig. 3 (b). It was found that all threshold voltages were found positive and threshold voltage (swept up) was the largest at 600 °C and the film (500 °C) exhibited the smallest degree of threshold voltage. Moreover, the threshold voltage (swept down) was gradually increased with increasing process temperature. From Fig. 3 (c), all flat band voltage was examined to be negative values. To examine the ferroelectricity of PT film, hysteresis loop at the applied frequency of 100 kHz was tested by Sawyer-Tower circuit. Fig. 4 (a~e) showed the process temperature dependence of the hysteresis loop. These loops were symmetric and slim in shape. Saturation properties ( $2P_r-V$ ) at different process temperatures were plotted in Fig. 5 (a). From the figure, it was clear that the remanent polarization density was linearly increased with increasing process temperature at low voltage region and reached the constant value after 6V. The spontaneous polarization densities were also derived from ferroelectric hysteresis loops. Dispersion of spontaneous polarization density at process temperature was illustrated at Fig. 5 (b). The coercive field of the fabricated film could be evaluated from hysteresis loops. Variation in coercive field and process temperature of PT films was described in Fig. 5 (c).

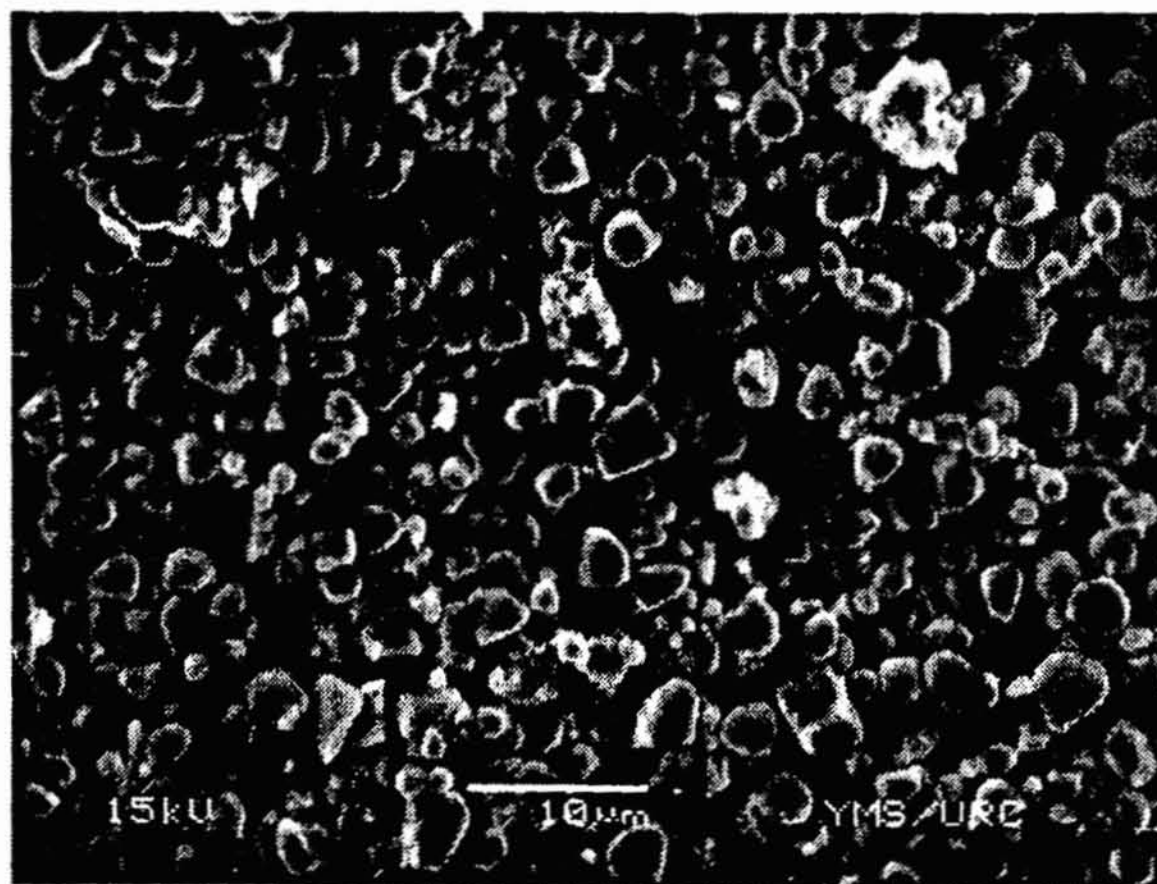


Figure 1. (a) SEM image of PbTiO<sub>3</sub> film (process temperature at 500 °C)

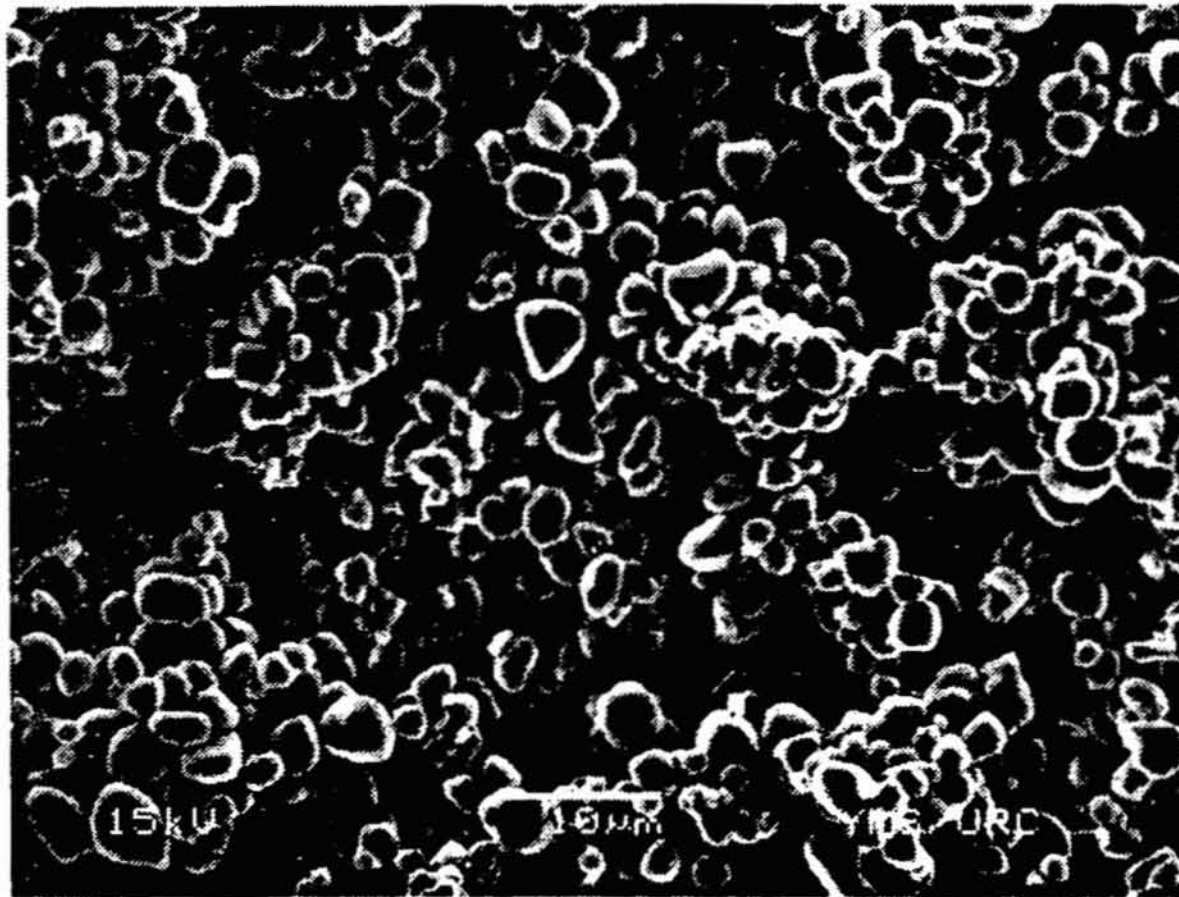


Figure 1. (b) SEM image of PbTiO<sub>3</sub> film (process temperature at 550 °C)

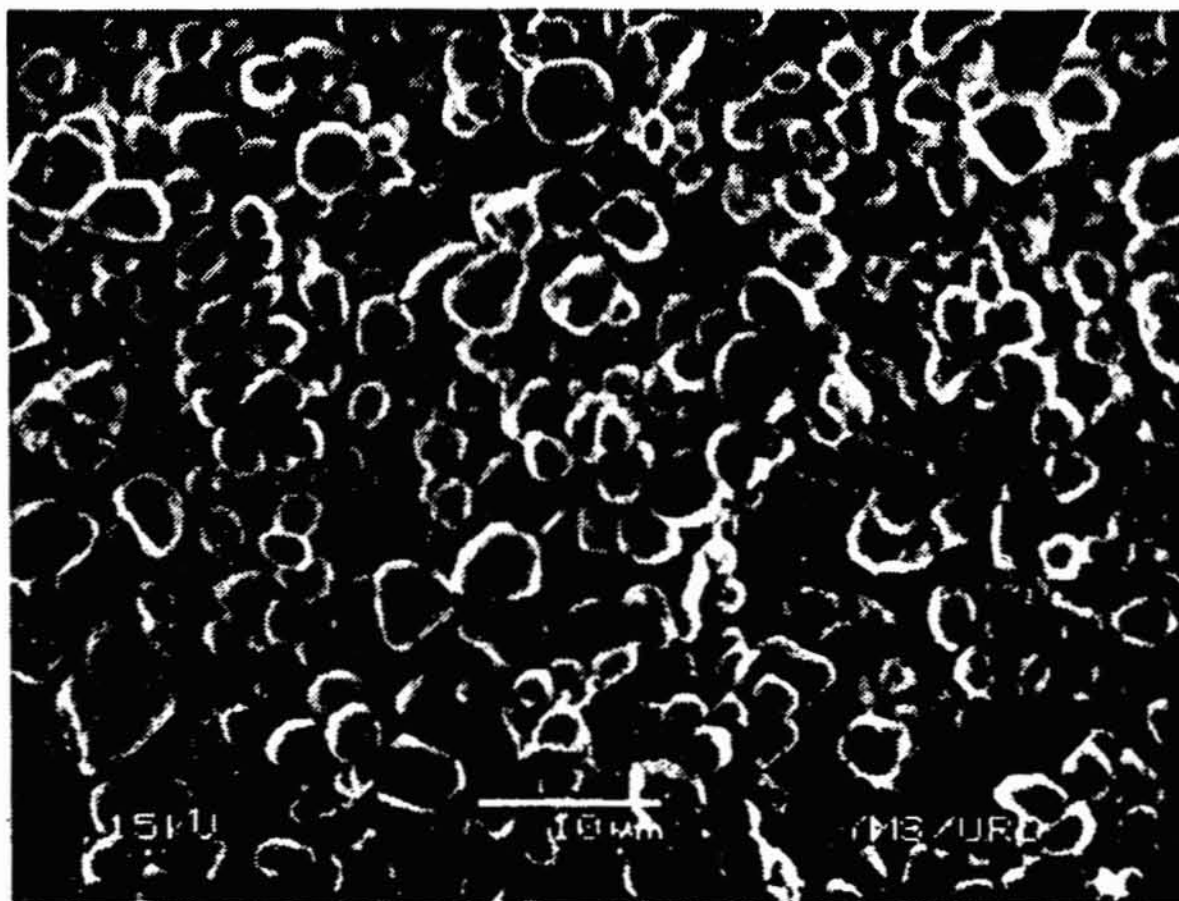


Figure 1. (c) SEM image of PbTiO<sub>3</sub> film (process temperature at 600 °C)

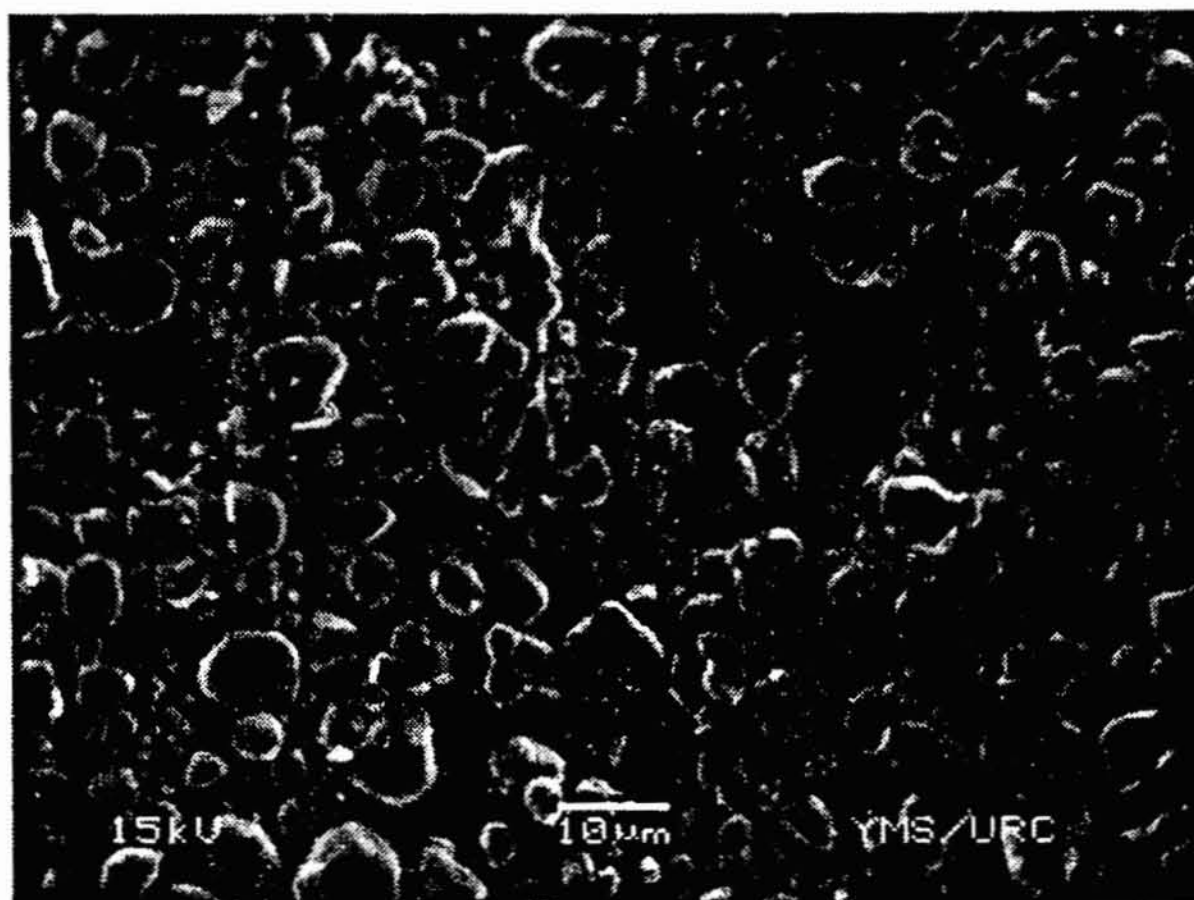


Figure 1. (d) SEM image of PbTiO<sub>3</sub> film (process temperature at 650 °C)

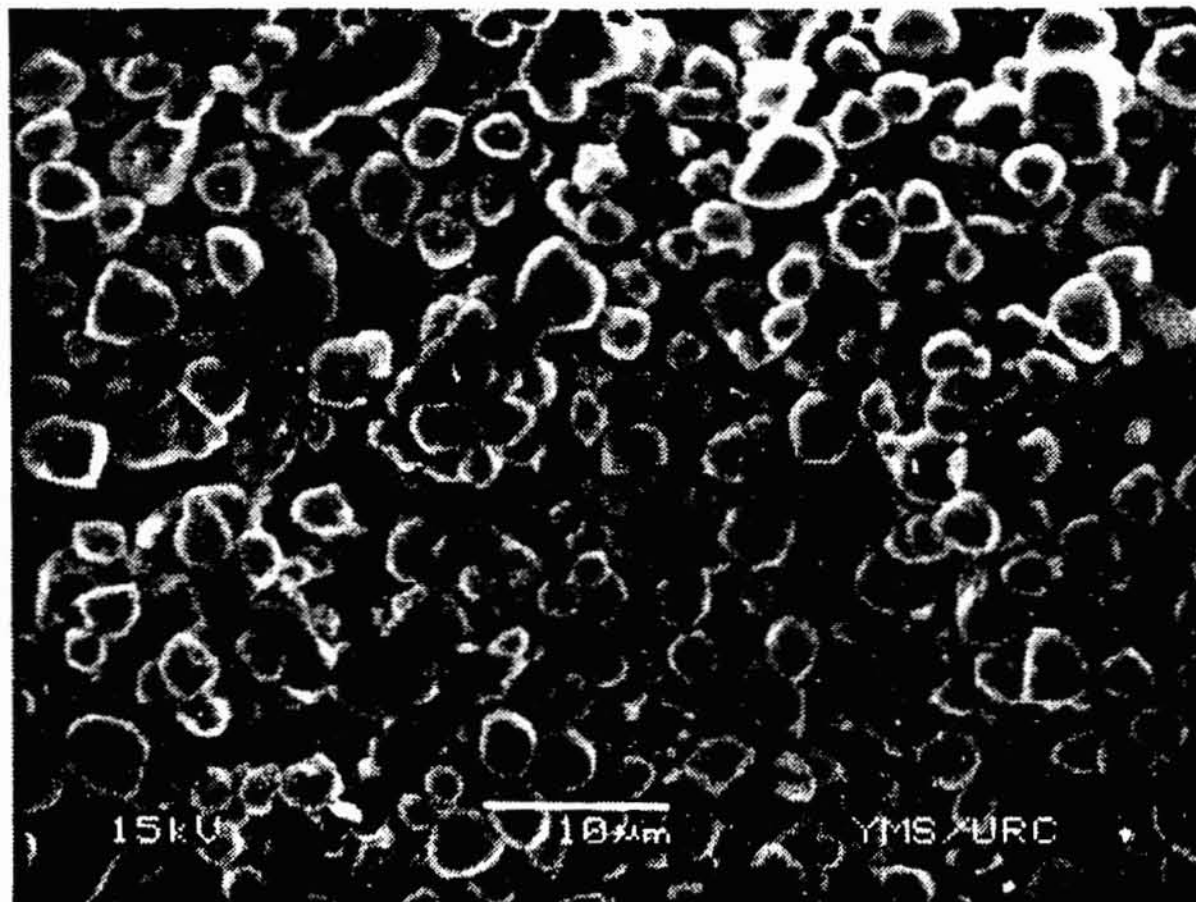


Figure 1. (e) SEM image of PbTiO<sub>3</sub> film (process temperature at 700 °C)

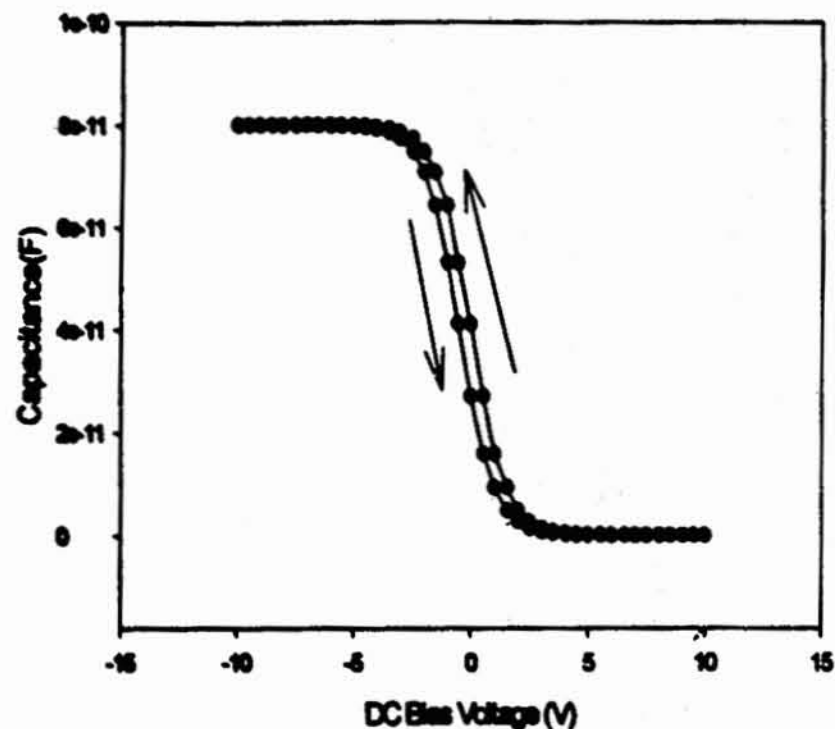


Figure 2 (a) Capacitance-Voltage characteristics of  $\text{PbTiO}_3$  thin film (process temperature at  $500^\circ\text{C}$ )

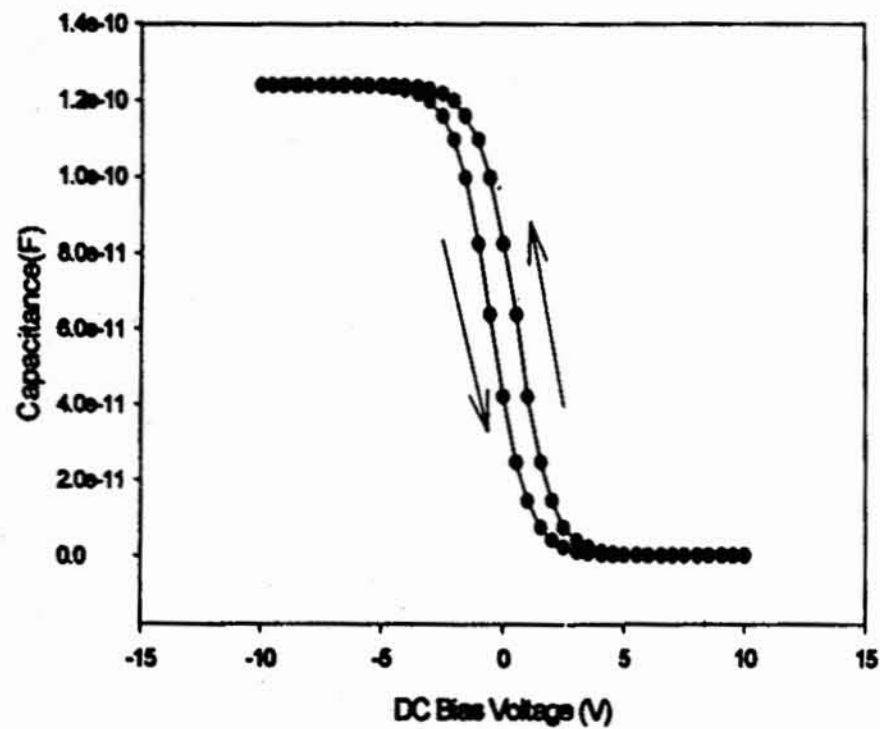


Figure 2 (b) Capacitance-Voltage characteristics of  $\text{PbTiO}_3$  thin film (process temperature at  $550^\circ\text{C}$ )

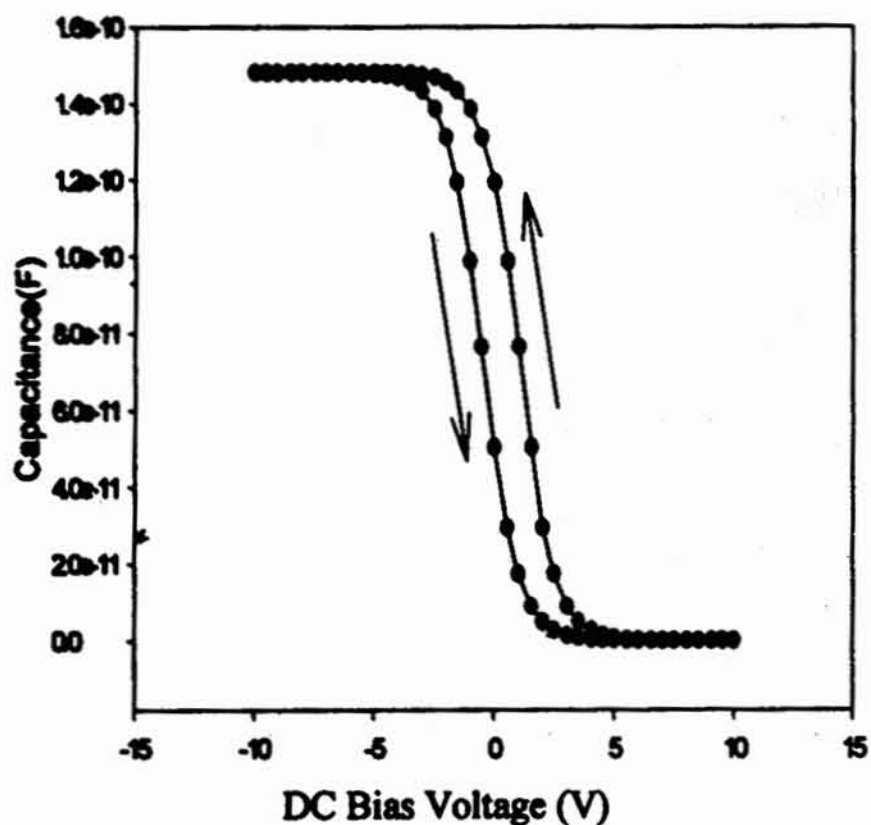


Figure 2. (c) Capacitance-Voltage characteristics of  $\text{PbTiO}_3$  thin film (process temperature at  $600^\circ\text{C}$ )

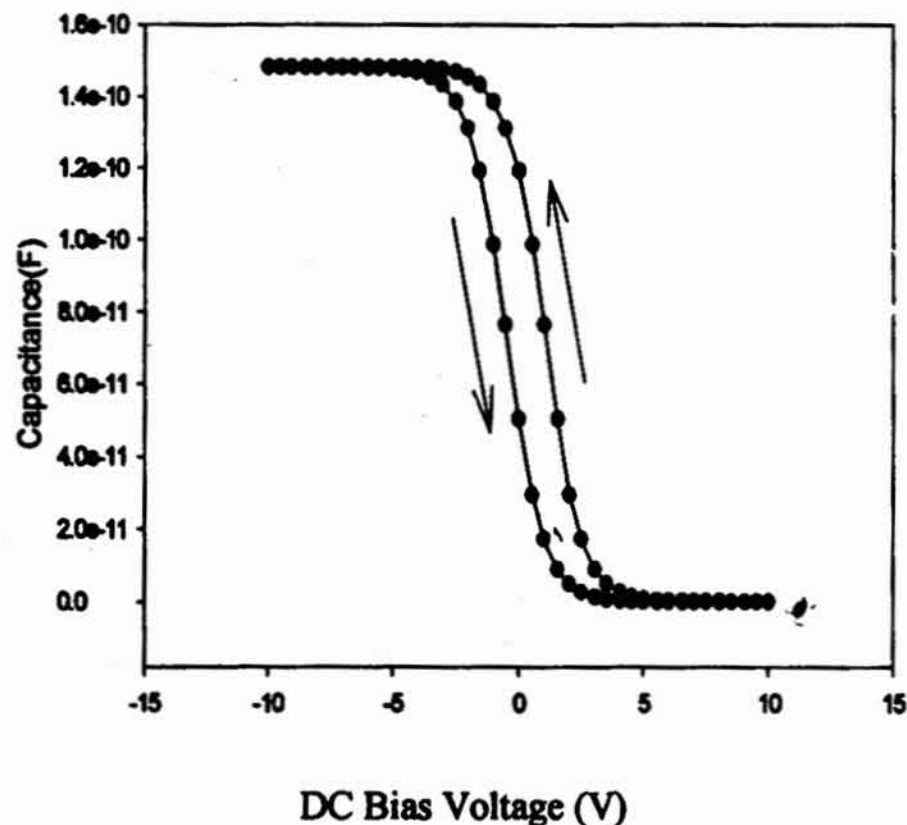


Figure 2. (d) Capacitance-Voltage characteristics of  $\text{PbTiO}_3$  thin film (process temperature at  $650^\circ\text{C}$ )

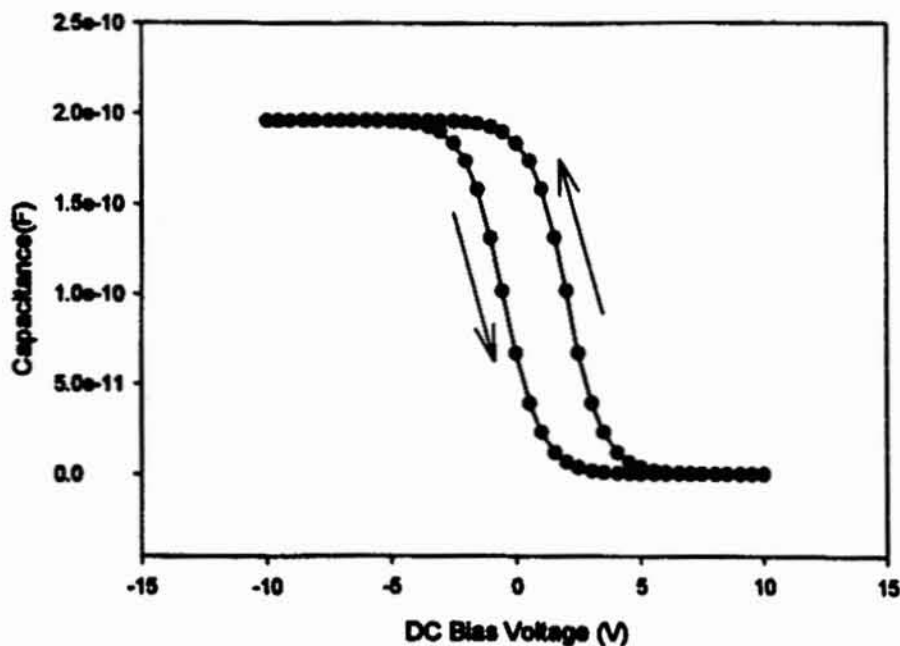


Figure 2. (e) Capacitance-Voltage characteristics of PbTiO<sub>3</sub> thin film (process temperature at 700 °C)

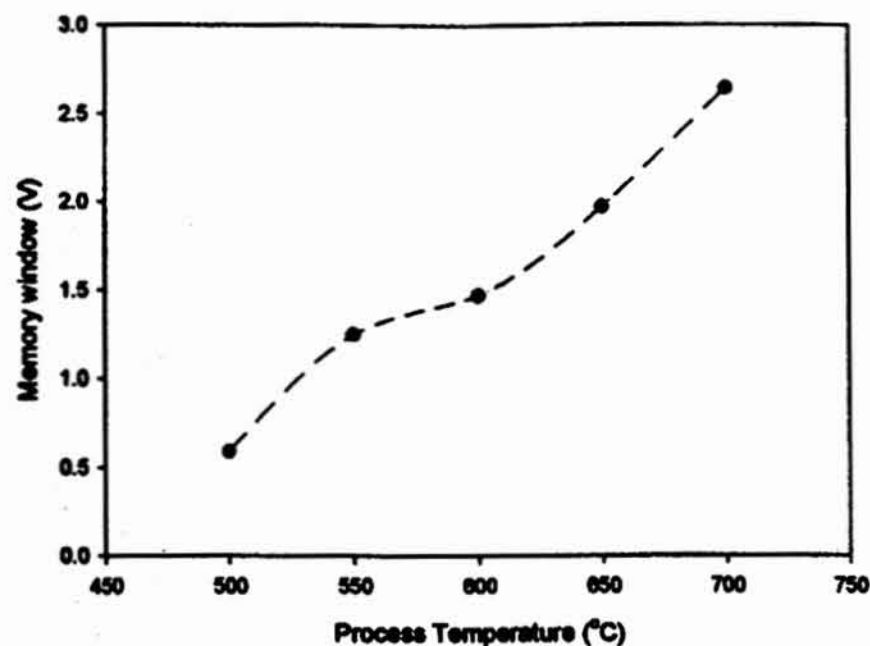


Figure 3. (a) Process temperature dependence of threshold voltage of PbTiO<sub>3</sub> thin film

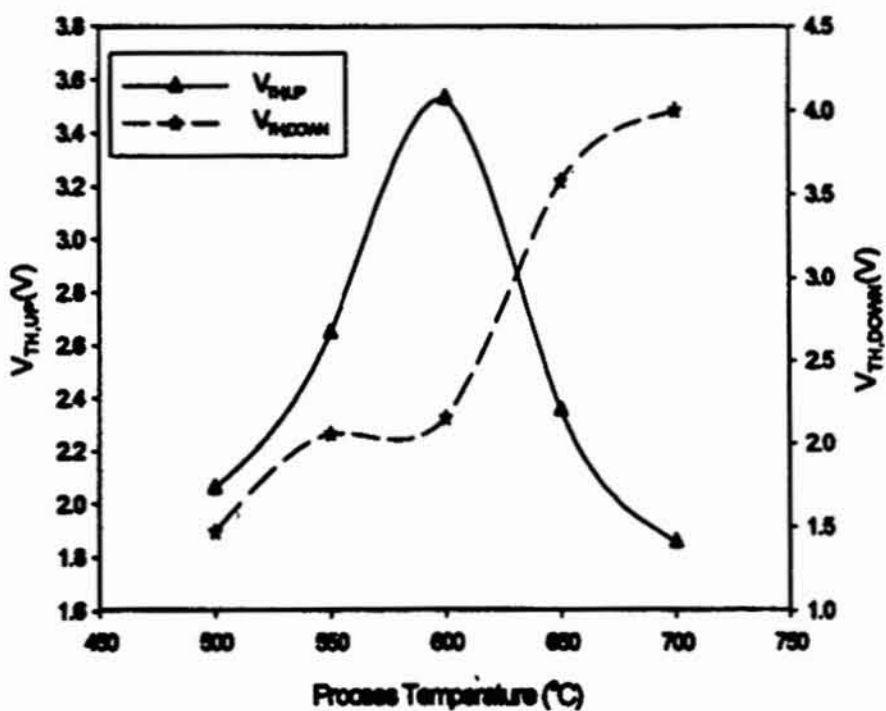


Figure 3. (b) Process temperature dependence of threshold voltage of PbTiO<sub>3</sub> thin film

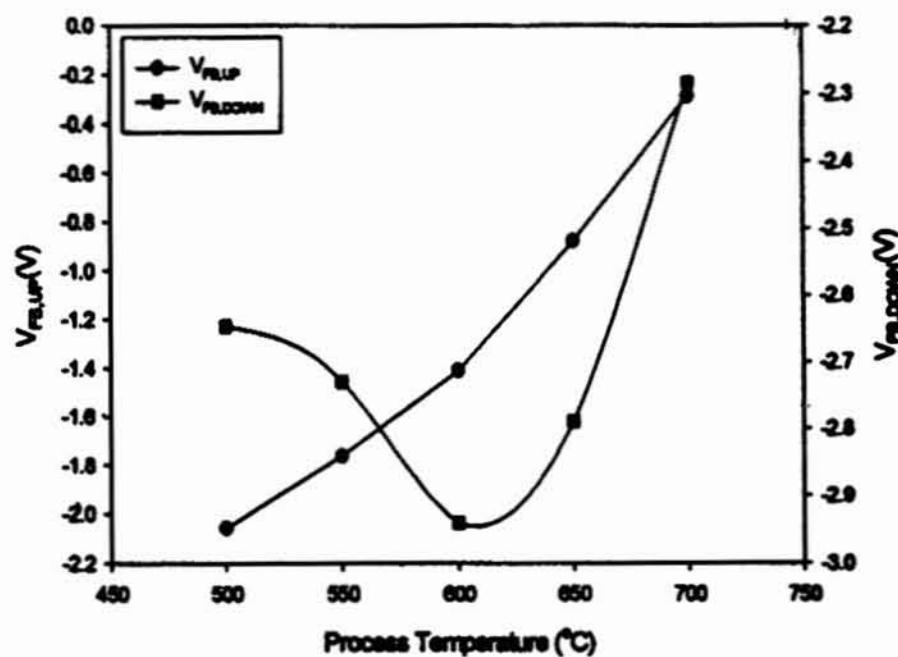


Figure 3. (c) Process temperature dependence of the flatband voltage of PbTiO<sub>3</sub> thin film

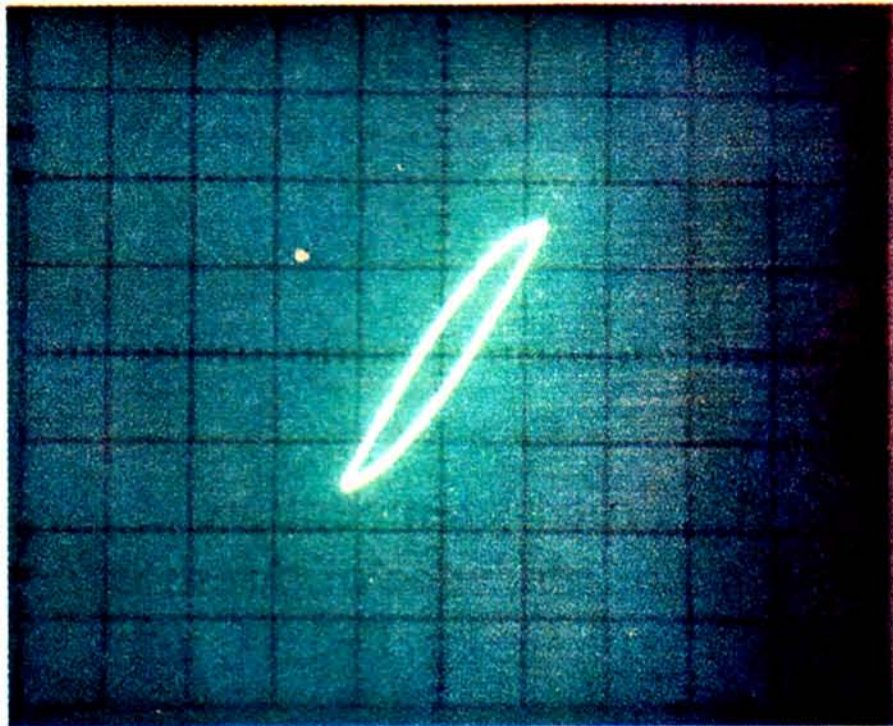


Figure 4. (a) P-E hysteresis loop of PbTiO<sub>3</sub> film (process temperature at 500 °C)

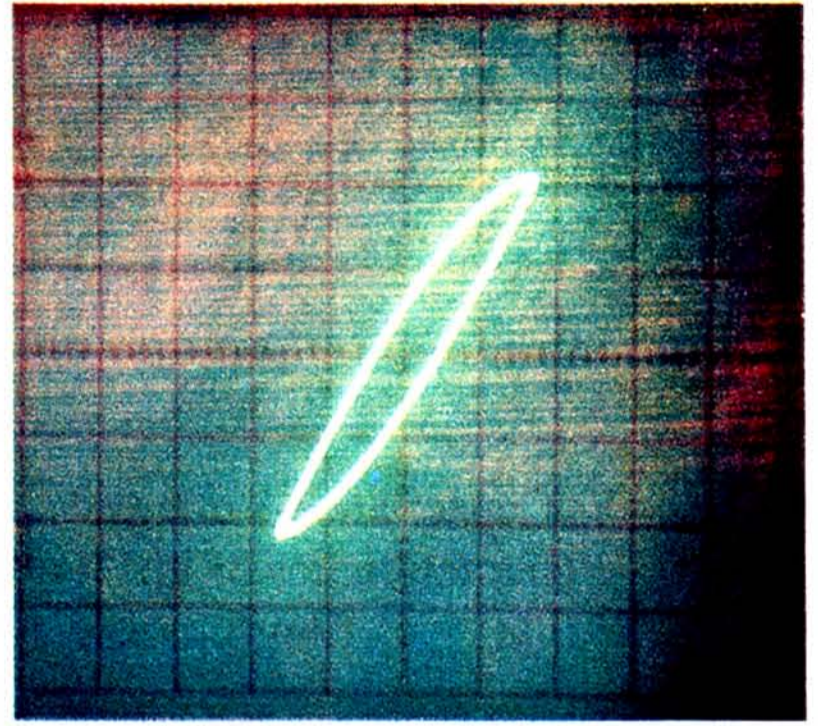


Figure 4. (b) P-E hysteresis loop of PbTiO<sub>3</sub> film (process temperature at 550 °C)

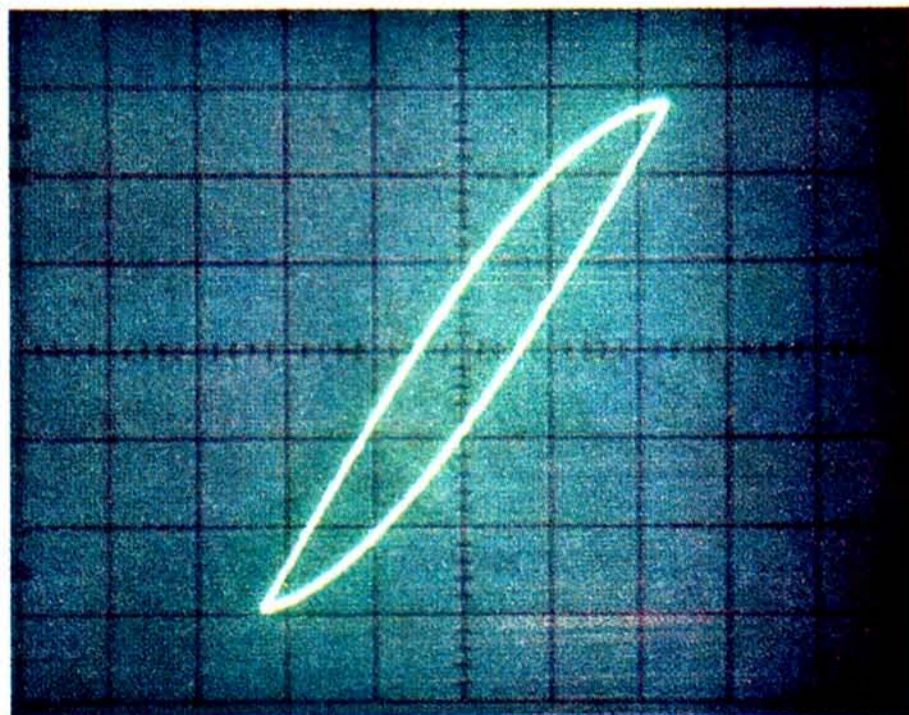


Figure 4. (c) P-E hysteresis loop of PbTiO<sub>3</sub> film (process temperature at 600 °C)

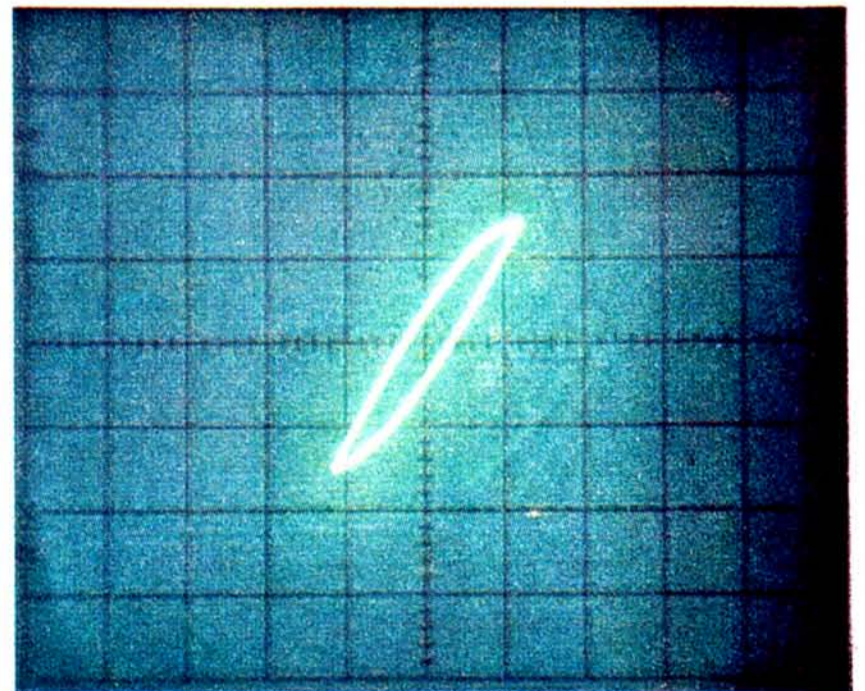


Figure 4. (d) P-E hysteresis loop of PbTiO<sub>3</sub> film (process temperature at 650 °C)

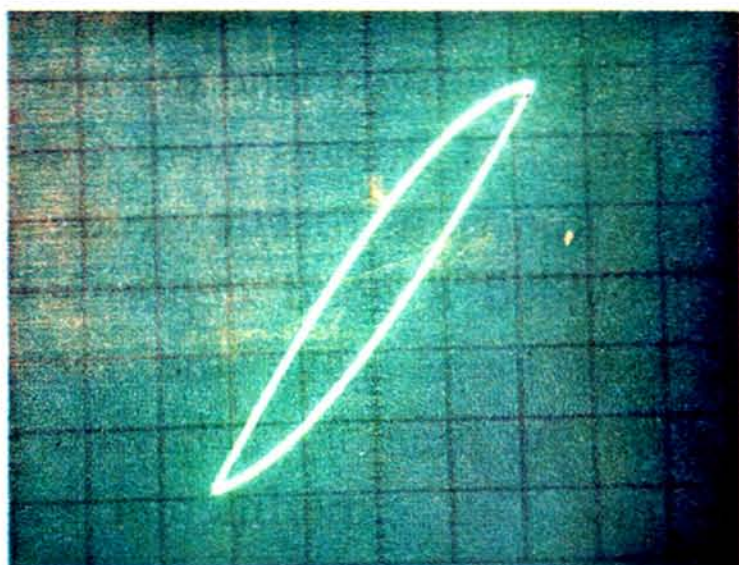


Figure 4. (e) P-E hysteresis loop of PbTiO<sub>3</sub> film (process temperature at 700 °C)

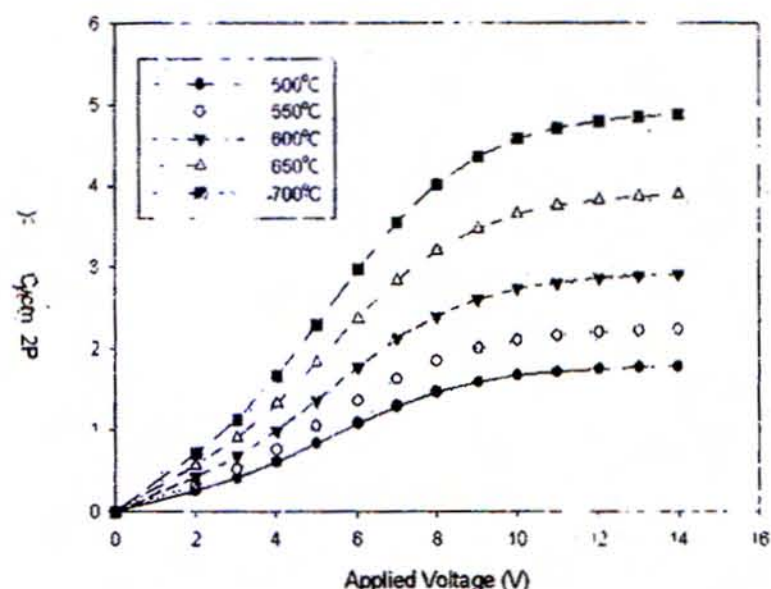


Figure 5. (a) Saturation properties of lead titanate thin film

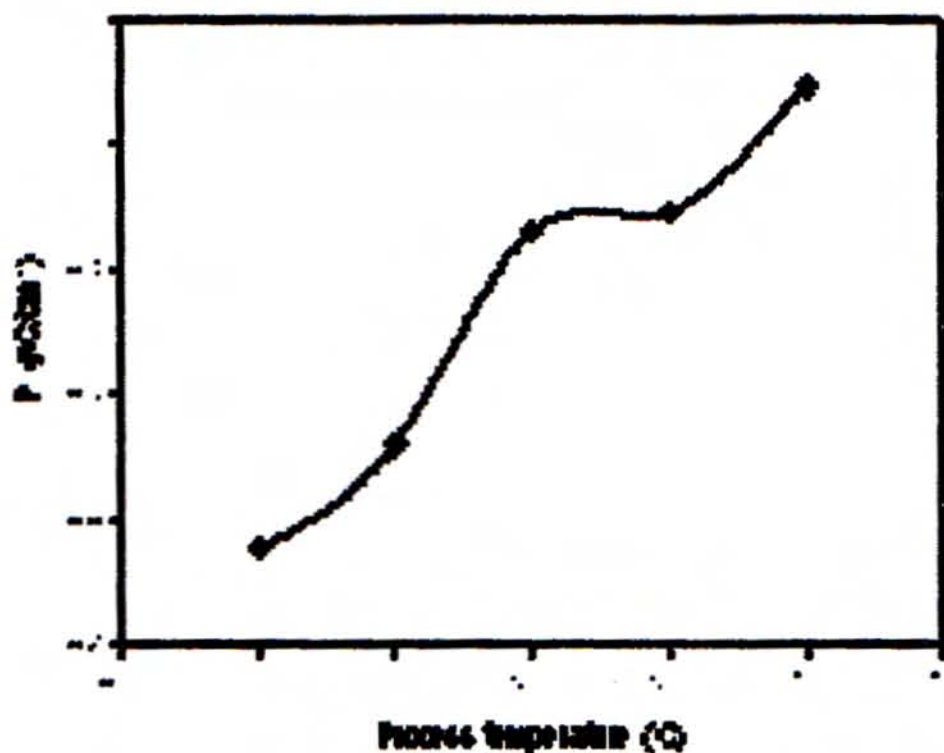


Figure 5. (b) Process temperature dependence of the spontaneous polarization density of PbTiO<sub>3</sub> thin film

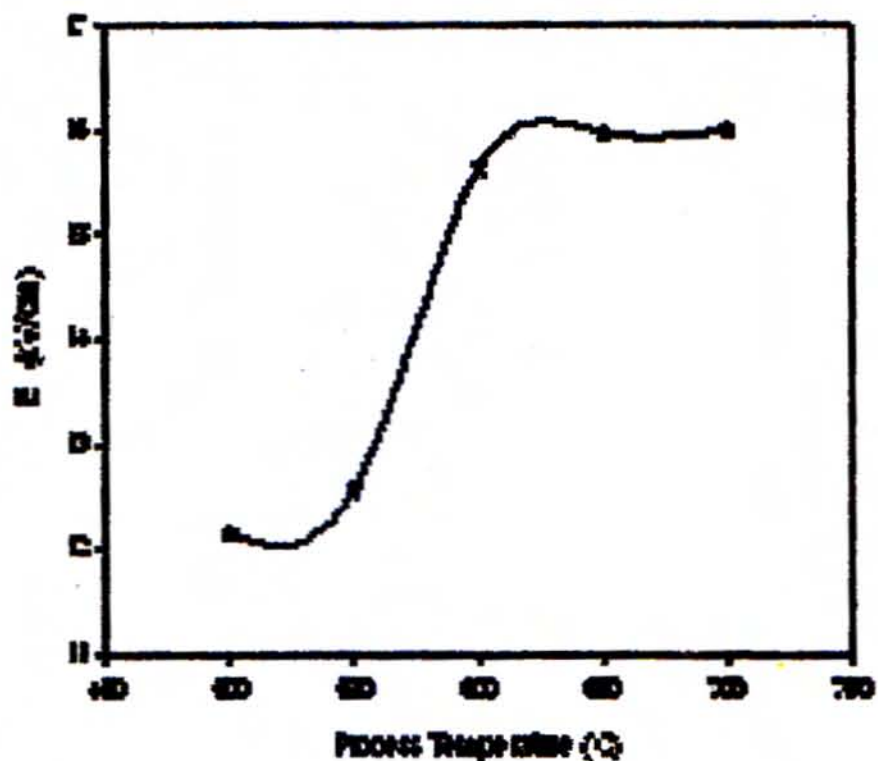


Figure 5. (c) Process temperature dependence of the coercive field of PbTiO<sub>3</sub> thin film



## Conclusion

Fabrication and characterization of sol-gel derived lead titanate thin film have been successfully investigated. All SEM images were flat and creak-free. They consisted of circular features known as rosette structure. It was well-known that lead titanate film provided a good deposition on substrate. Counter-clockwise C-V hysteresis loops gave the memory function. All P-E hysteresis loops also gave the memory behaviour and ferroelectric properties of lead titanate film. Our experimental results indicated strongly that the sol-gel derived PT film was quite feasible for non-volatile memory device application.

## References

- Hirotsuka O, Atsushi Y and Hidekazu T. (2005). Effects of Ca substitution for Sr on ferroelectric properties and crystal structure of  $(\text{Sr}_{1-x}\text{Ca}_x)\text{Bi}_2\text{Ti}_2\text{NbO}_{12}$ , *Jpn. J. Appl. Phys.*, 44 (9B) 7003-7007
- Mamoru O., Hironori F, Masaru S., Hirohiko N. and Koichiro H. (2005). Piezo- and ferroelectric properties of self-assembled  $\text{PbTiO}_3$  nanoisland structures fabricated by metalorganic chemical vapor deposition, *Jpn. J. Appl. Phys.*, 44 (9B) 6891-6894
- Matthew T. (2001). Ferroelectricity: Measurement of the dielectric susceptibility of strontium titanate at low temperature, *Am. J. Phys.*, 69 (9) 966-969
- Yiji N., Masayuki S., Masatake T. and Masaru M. (2005). Oxygen stability and leakage current mechanism in ferroelectric La-substituted  $\text{Bi}_4\text{Ti}_3\text{O}_{12}$  single crystals, *Jpn. J. Appl. Phys.*, 44 (9B) 6998-7002