



**INTERNATIONAL CONFERENCE ON  
METALLURGICAL COATINGS  
AND THIN FILMS**

**PROGRAM AND ABSTRACTS**

**Town and Country Hotel  
San Diego, California  
May 1-5, 2006**

**Sponsored by:  
Advanced Surface Engineering Division  
of AVS**



experimental results exhibits that the degradation of p-type TFTs is caused not only by the generation of states between the junction of drain and channel of poly silicon film, but also the fixed charges at the oxide and silicon interface.

**HP-19 Statistical Study on the States in the Low-Temperature Poly-Silicon Films with Thin Film Transistors, S.Z. Huang** (*hansley.eo92g@nctu.edu.tw*), Y.P. Chou, Y.H. Tai, National Chiao Tung University, Taiwan

Laser recrystallized low temperature poly-silicon films have attracted attention for their applications in thin-film transistors (TFTs), which are widely used in active matrix displays. The electrical characteristics of the poly-silicon film can vary because of the grain boundaries. In this work, the variation is statistically studied with the threshold voltage ( $V_{th}$ ) and mobility of the TFTs. The threshold voltage and mobility of many closely-located TFTs are measured. These two parameters correspond to the deep states and tail states of the poly-silicon film, respectively. The threshold voltage exhibits the distribution in a Gaussian-Lorentzian cross product form. The  $V_{th}$  differences between many pairs of devices are calculated. It is found that the average of  $V_{th}$  difference increases with distance of the pairs, but the deviation is constant with distance of the pairs. On the other hand, the mobility exhibits an asymmetric distribution, and both the average and deviation of the mobility difference for pairs of devices do not change with the distance of the pairs. This result directly reflects the local fluctuations and the spatial trends of the deep and tail states in a poly-silicon film. The models describing  $V_{th}$  and mobility with different distance are also proposed.

**HP-20 Electrical Characteristics of  $(Ba_{0.7}Zr_{0.3})(Ti_{0.9}Zr_{0.1})O_3$  Thin Films Deposited Using RF Magnetron Sputtering for Dynamic Random Access Memory Application, K.-H. Chen** (*d9131802@student.nsysu.edu.tw*), National Sun Yat-Sen University, Taiwan

Recently, many kinds of memory devices had been discussed, such as the dynamic random access memory (DRAMs), the flash memory, FeRAM, MRAM and etc. Among the volatile and nonvolatile memory devices, the non-destructive readout feature of higher density and storage capacity nonvolatile memory device will play an important role in the future. In this study,  $(Ba_{0.7}Zr_{0.3})(Ti_{0.9}Zr_{0.1})O_3$  ferroelectric thin film successfully as-deposited and annealed on Pt/Ti/SiO<sub>2</sub>/p-Si substrate using rf magnetron sputtering, and their electrical and physical characteristics would be investigated and discussed. The maximum dielectric constant and lower leakage current density of thin films were about 192 and  $10^{-7}$  A/cm<sup>2</sup>, as the optimal sputtering parameters, such as the power of 160 W, the chamber pressure of 10 mTorr, substrate temperature of 580°C and oxygen concentration of 25%. In addition, the excellent dielectric constant and leakage current density of as-deposited annealed under the rapid temperature annealing (RTA) and conventional furnace annealing (CFA) would be found, and those were 420 and  $10^{-8}$  A/cm<sup>2</sup>, respectively, as annealing temperature increased 700°C. Finally, the experimental results obtained indicated the correlation between the electrical characteristics and thin films deposited and annealed under different post-treatment process for larger storage capacity and higher density of dynamic random access memory devices in this study.

**HP-21 Characteristics of Interfacial Bonding Distribution and Energy Band Gap of  $(Gd_{1-x}Pr_x)_2O_3$  /GaAs(001) System, S.G. Choi, Hyung-H. Park** (*hhpark@yonsei.ac.kr*), Yonsei University, Korea

Over the last three decades, a variety of attempts to develop an insulator-GaAs system have been made with SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub>, CaF<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Ga<sub>2</sub>O<sub>3</sub>(Gd<sub>2</sub>O<sub>3</sub>) and so on, because of low leakage current and high dielectric strength. However, their applications were often restricted by the instability of the GaAs surface. Among the candidates for gate oxide on GaAs, epitaxial Gd<sub>2</sub>O<sub>3</sub> films have been reported with the development of molecular beam epitaxy and ultra high vacuum process. However, it still exists a lattice mismatch approximately as +1.9% and -3.9% because of a long-range (3.528 nm x 1.535 nm) ordering of Gd<sub>2</sub>O<sub>3</sub> (440) on GaAs (001) substrate. It could induce misfit dislocation at the interface and the pinning of Fermi level on the surface of GaAs. In this work, cation Gd in Gd<sub>2</sub>O<sub>3</sub> is substituted with Pr, with a larger ionic radius than that of Gd, to control the lattice parameter of cubic C-type rare earth structure. Pr<sub>2</sub>O<sub>3</sub> crystallizes with hexagonal structure in its stable form. Metastable cubic form has been reported with a lattice constant of 1.115 nm, 2.6% larger than that of Gd<sub>2</sub>O<sub>3</sub> (a=1.087 nm). Therefore, it could be expected that small amounts of Pr<sub>2</sub>O<sub>3</sub> should homogeneously alloy with Gd<sub>2</sub>O<sub>3</sub>, resulting in adjustable lattice constant. The electrical properties of metal-oxide-semiconductor(MOS) diodes were correlated with crystalline properties and band offset to demonstrate the feasibility for MOS field effect transistor application. Sulfur passivation was adopted to form an oxidation-proof layer during the

formation of gate oxide films. The change of energy band structure was estimated using photoemission and absorption spectroscopy.

**HP-22 Effect of Sulfuric Acid Treatment on Bioactivity of TiO<sub>2</sub> Coatings, X. Zhao, X. Liu, C. Ding**, Chinese Academy of Sciences, PR China, P.K. Chu (*paul.chu@cityu.edu.hk*), City University of Hong Kong, PR China

In recent years, some ceramics, such as HA, wollastonite and bioglass (BG), were deposited onto titanium substrate using plasma spraying technology and exhibited an excellent application foreground as orthopedic and dental implant materials. However, these coatings often lead to a dissolution from the implants and result in failure or have a poor adhesion to substrate. Plasma sprayed TiO<sub>2</sub> coatings on titanium alloy substrates as bond coatings and composite coatings have recently demonstrated promising corrosion behavior in vivo, acting as chemical barrier against the release of metal ions from the implant. TiO<sub>2</sub> powders and films can exhibit bioactivity in many applications, but plasma-sprayed TiO<sub>2</sub> coating is always bioinert. In this work, TiO<sub>2</sub> coatings on titanium alloy substrates were prepared by atmospheric plasma spraying using commercial nano-powders. A chemical treatment method was employed to induce bioactivity on the TiO<sub>2</sub> surface. As-sprayed coatings were treated using sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) of different concentration at room temperature for 24 hours. The bioactivity of these H<sub>2</sub>SO<sub>4</sub>-treated TiO<sub>2</sub> coatings were evaluated by investigating the formation of apatite on their surface after they were soaked in simulated body fluid for a period of time. The results obtained indicated that H<sub>2</sub>SO<sub>4</sub>-treated TiO<sub>2</sub> coating can induce bone-like apatite formation on its surface but apatite cannot form on the surface of the as-sprayed TiO<sub>2</sub> coating. The concentration of H<sub>2</sub>SO<sub>4</sub> play an important role in bioactivity and the bioactivity was lost when the concentration of H<sub>2</sub>SO<sub>4</sub> decrease to 0.01M. The formation of a hydrogenated surface which gives rise to negatively charged functional groups was thought to be the primary reason to induce bioactivity of TiO<sub>2</sub> coating.

**HP-23 Dissolution and Mineralization of Plasma-Sprayed Dicalcium Silicate/Zirconia Composite Coatings, Y. Xie, X. Liu, X. Zhao, C. Ding**, Chinese Academy of Sciences, PR China, P.K. Chu (*paul.chu@cityu.edu.hk*), City University of Hong Kong, PR China

Dicalcium silicate / Zirconia composite coatings were produced on Ti-6Al-4V substrates using atmospheric plasma spraying. The feedstocks consisted of mechanically blended powders of different dicalcium silicate to zirconia weight ratios (5:5, 3:7, and 1:9). The microstructure and phase composition of the three coatings were assessed by scanning electron microscopy and X-ray diffraction. The bioactivity of the coatings was evaluated in vitro by immersion in a simulated body fluid. The surface mineralization and dissolution behaviors in simulated body fluid were studied and the changes in the Ca, Si, and P concentrations were monitored by inductively-coupled plasma atomic emission spectroscopy. Our dissolution study in a Tris-HCl buffer demonstrated reduced dissolution rates and increased surface stability with higher zirconia contents. The rapid dissolution of dicalcium silicate resulted in a higher Ca concentration and rapid precipitation of bone-like apatite on the composite coating surfaces thereby expediting initial bone fixation. The results showed that the addition of zirconia that possesses high mechanical strength and anti-corrosion properties effectively improves the stability of the composite coatings and the long-term performance in a biological environment.

**HP-24 Synthesis and Characteristics of Lanthanum Oxide Films by Dual Plasma Deposition and In Vitro Evaluation of Endothelial Cells Cultured on the Films, F.J. Jing, R.K.Y. Fu, X.B. Zhao**, City University of Hong Kong, PR China, N. Huang, Southwest Jiaotong University, PR China, P.K. Chu (*paul.chu@cityu.edu.hk*), City University of Hong Kong, PR China

Endothelialization of cardiovascular device surfaces has been regarded as an important means to prevent thrombogenicity. However, up to now, there have been few reports about the compatibility between rare-earth materials and blood. In this work, a rare earth oxide film, lanthanum oxide, was fabricated using dual plasma deposition and the influence of the film properties on the endothelial cell behavior was investigated. The structure, physicochemical characteristics, as well as surface biomedical compatibility were determined by X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), Rutherford backscattering spectrometry (RBS), and atomic force microscopy (AFM). The surface wettability and tension were characterized by contact angle measurement. Human umbilical vein endothelial (HUVE) cells were cultured on the surfaces of the as-deposited films. Scanning electron microscopy (SEM) and optical microscopy were used to evaluate the surface morphology of the endothelial cells on the surface of films. The results show that HUVE cells can adhere and proliferate on the surface of the lanthanum oxide films in vitro. This study suggests rare earth oxide films are potential blood-contacting biomedical materials.