Applied Surface Science
Room Exhibit Hall C&D - Session AS-MoP
Aspects of Applied Surface Science Poster Session

AS-MoP2 Unusual Interdiffusion Reactions in Multilayer ZrO@sub 2@CaO/Fe/Si Thin Films*, H. Piao, L. Le Tarte, L. Denault, J.R. Cournoyer, K. Dovidenko, M. Larsen, J. Osaheni,* General Electric Co., Global Research Center

Interdiffusion reactions in multilayer ZrO@sub 2@CaO/Fe/Si thin film (2mm diameter dot) have been studied using X-ray Photoelectron Spectroscopy (XPS) in combination with Scanning Auger Microscopy (SAM), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The 2mm diameter thin film dots were prepared through a shadow mask by depositing Fe and ZrO@sub 2@CaO sequentially on silicon substrates, followed by thermal treatments. It was found that heating at elevated temperatures resulted in the segregation of the islands on the substrate with the accompanying formation of irregular shaped pits in the film. The diameters of the islands are typically in the range from 100 to 250nm. XPS and SAM results on these islands indicated that the islands are mainly iron silicide coated with Fe, Zr-Ca and Si oxide towards to the surface. The formation of the interfacial iron silicide (FeSi@sub 2@) arising from the bulk interdiffusion of Fe and Si were confirmed by XPS, TEM, and SAD (selected area diffraction) studies. Much more surprising is the surface enrichment of silicon oxide on the whole dot surface. The fast segregation of silicon from the substrate to the surface does not appear to be via bulk interdiffusion. The implications of these findings to the diffusion properties of the thin film will be discussed.

AS-MoP3 Synthesis and Characterization of Spectroscopic Tags Based Surface-Enhanced Raman Spectroscopy (SERS) of BPE Adsorbed on Gold Nanoparticles*, **M.C. Burrell**,* GE Global Research Center

Nanoparticle tags detectable by Raman spectroscopy, due to the surface-enhanced Raman effect (SERS) of adsorbed reporter molecules, have potential applications ranging from biological assays to cellular imaging. This paper describes the surface chemistry considerations, and characterization methods employed, in producing gold nanoparticles with an adsorbed bis(4-pyridyl) ethylene [BPE] reporter molecule. The SERS response of the tags is affected by the size of the gold nanoparticles, the adsorption conditions of the BPE, and co-adsorption of precursors for growth of protective shells. A primary consideration in producing tags is preventing aggregation of the particles, even though the SERS enhancement of individual particles is lower than aggregates. We will present data from Raman spectroscopy, UV-visible absorbance, light scattering, and TEM to used to characterize the tags during the synthesis process.

AS-MoP4 Dimensional Effects of Metal Nanoparticles on Their Characterization by X-ray Photoelectron Spectroscopy*, **D.-Q. Yang**, E. Sacher,* Ecole Polytechnique of Montreal, Canada

X-ray photoelectron spectroscopy (XPS) has been found very useful in the understanding of the electronic states of supported metal catalyst nanoparticles. We give a short review on the photoelectron emission behaviour of nanoparticles deposited on several relatively unreactive substrate surfaces, including highly oriented pyrolytic graphite (HOPG) with varying surface defects densities, and low permittivity polymers. We fix our attention on the (1) photoelectron emission yield enhancement induced by the nanoparticles, (2) photoelectron emission from the shell and the core of the nanoparticles, (3) size-dependent binding energy shifts, (3) Auger parameters, (4) Wagner plots and (5) initial-state and final-state effects on the nanoparticle dimensions and their substrate surface interactions. Intensity ratios, from a given nanoparticle at two different kinetic energies, as well as from nanoparticle and substrate, and their dependences on nanoparticle dimensions, are also explored.

AS-MoP5 Thickness Measurement Of Diamond-Like Carbon (DLC) By Auger Electron Spectroscopy (AES)*, Y. Zheng, **B. Lu**,* Seagate Technology (RMO) Ltd*; G. Selvaduray,* San Jose State University

Abstract-To increase the density of magnetic recoding disks and to protect the magnetic layers from sliding contact and corrosion, it is important to be able to accurately measure the thickness of DLC films. The ability to use AES to measure the DLC thickness on magnetic recording disks was studied. The principle of DLC thickness measurement was based on Beer-Lambert's law. The approach was to construct a working curve by using the thickness of DLC measured by ESCA and the intensities of the carbon and cobalt signals detected by AES to generate the calibration parameter " ". This study demonstrated that the DLC thickness could be measured by AES, employing the intensities of the cobalt signal present in the magnetic layer. Statistical analyses verified that there were no significant differences between the DLC thickness measured by ESCA and those measured by AES.

AS-MoP6 Structural Analysis of a DTHXBQ/Pt(dmg)@sub 2@ on KBr Plate used by TRXPS*, T. Tazawa, **Y. Iijima**,* JEOL Ltd., Japan*; S. Isoda,* Kyoto University, Japan

Recently, with development of thin film technique, analysis of the molecular film which did lamination in a structural analysis of monomolecular film and thickness of several nm has been demanded from X-ray photoelectron spectrometer (XPS). Because this material is formed on flat plate, such as silicon wafer, it is possible to measure with total reflection x-ray photoelectron spectrometer (TRXPS). A location of standing wave changes when it changes in X-ray incidence angle in TRXPS. This change does intensity change of photoelectron intensity, and it is observed. Variation that is to say occurs in photoelectron intensity by an entity location, a difference of angle in the same functional group. Firstly film formation did Pt(dmg)@sub 2@ in thickness of 15nm on KBr plate by this study, and DTHXBQ film (organic compound) formed on that film, after that we measured this organic compound film used by TRXPS. Measurement changed incidence X-rays from 10° to 0°, and we measured photoelectron intensity-dependence of Pt4f, O1s, C1s and N1s for incidence angle of x-ray. The insturment which we used for measurement is JPS-9200 (JEOL Ltd.). Measurement condition is as follows. Excitation x-ray is AlK@alpha@ monochromatic X-ray, x-ray power in measurement is 300W, and energy resolution is 0.8eV. As a result, we were able to decided a location of Pt in Pt(dmg)2,and a structure of Pt(dmg)@sub 2@ and DTHXBQ films on KBr plate.

AS-MoP7 Investigation of Pharmaceutical Packaging Materials using XPS and TOF-SIMS*, **X. Dong**, R.G. Iacocca, J. Janimak, M.C. Allgeier,* Eli Lilly

The surface composition of packaging materials is of great interest to the pharmaceutical community because of potential interactions between the packaging surface and the drug product. The surface sensitivity of XPS and TOF-SIMS makes these techniques ideally suited to the surface characterization of packaging materials. In this work, XPS was utilized to evaluate surface compositions of three Type I glass vials from different sources. The bulk compositions of three glass vials are similar to each other, and the surface of one glass vial is ammonium sulfate treated. To thoroughly understand the surface composition, survey and high resolution spectra, as well as small spot images, were collected from all three samples. The XPS results revealed marked difference in surface compositions of the three vials. Significantly higher amounts of B and Na were detected on one vial than on the other two, suggesting that this glass had been exposed to excessive heat. Sodium sulfate residues were present on the ammonium sulfate treated vial, suggesting the rinsing process performed by the manufacturer is not thorough enough. In addition to glass vials, plastic liners, another commonly used packaging material for Active Pharmaceutical Ingredient (API) powders, were also examined. API stored in plastic liners under different conditions were investigated, and compared to that stored in glass vials using TOF-SIMS. It is obvious that the additives present on the surface of the plastic liner were transferred to the API during storage. The preliminary results also suggest that the increase of additives on the API is consistent with the decrease in surface area. This work clearly demonstrates that XPS and TOF-SIMS are highly valuable techniques in evaluation of pharmaceutical packaging materials, as well as in the investigation of the interactions between drug products and the packaging.

AS-MoP8 Determination of Equivalent Circuits of Surface Structures for XPS Analysis*, **O. Tasci**, U.K. Demirok, E. Atalar, S. Suzer,* Bilkent University, Turkey

XPS analysis of non-conducting samples is usually hampered due to charging, and a great deal of effort has been devoted to minimize it. However, it is also possible to utilize this charging to extract information related with dielectric properties of various surface structures. Determination of equivalent circuit(s) and testing on real samples emerge as essential parts of this analysis. To this end, we have carried out a number of experiments to determine the charging/discharging behavior of various surface structures consisting of Au, Ag, and Pt (metallic), Titania (semiconductor), and Silica (dielectric) Nanoparticles deposited on SiO@sub 2@/Si substrates by XPS. We have also constructed the corresponding equivalent circuits by using the PSPICE program and correlated the output with the experimental data. Our experimental results and their correlation with the model(s) will be discussed in detail.

AS-MoP9 Scanning Probe Microscopy and X-ray Photoelectron Spectroscopy Investigations of Focused Ion Beam-Irradiated Targets*, **K. Archuleta**,* Sandia National Laboratories*; J.L. Fenton,* University of New Mexico*; M.J. Vasile, S. Campin, D.P. Adams,* Sandia National Laboratories*; J.E. Fulghum,* University of New Mexico

Focused ion beam (FIB) techniques have a wide range of applications, from lithographic mask repair and semiconductor analysis to machining of microtools. As FIB prototyping methods are extended to the nanometer scale, the effects of distributed charge resulting from ion implantation/sputtering, modifications in near-surface chemistry, and evolved surface morphology become more relevant to device fabrication and operation. Toward this end, we investigate the residual electronic and chemical properties of ion-exposed areas. High energy (30 keV) focused ion beams are used to expose 100 Âµm wide features in Si, SiO2 and C substrates. Samples are then removed from the FIB system, and the residual surface potential and spatial distributions of charge are analyzed using ex-situ scanning surface potential microscopy and scanning capacitance microscopy. Changes in residual surface potential are evaluated over a large range of ion dose (~1016 -1018 ions/cm2); this includes conditions that lead to target swelling (low fluence) followed by constant-rate sputter erosion (high dose). The evolving chemistry of the near-surface region is also investigated as a function of ion dose. High spatial resolution, x-ray photoelectron spectroscopy provides insight into the changes of near-surface composition that occur during increased gallium ion exposure.

AS-MoP10 The Efficacy of Organosilane Surface Modifications on Distribution of Polar Inorganic Particles within a Nonpolar Polymer Matrix*, **A.K. Wertsching**, T.L. Trowbridge, P.J. Pinhero,* Idaho National Laboratory

Improving the surface interface of nonpolar and polar materials is critical to creating the desired physical properties of hybrid composites. Modification of inorganic particles with various organosilanes has the effect of creating a nonpolar surface on a polar material, which then can be dispersed into nonpolar media. However, choice of organosilane can have radically different results on the composite. The impact of the organosilane upon these composites are examined using scanning electron microscopy (SEM), atomic force microscopy (AFM), scanning Auger microscopy (SAM), and x-ray photoelectron spectroscopy (XPS).

AS-MoP11 Accurate Force Measurements in the AFM: Improvements in the MEMS Electrical Nanobalance Calibration Device*, **J. Portoles**,* National Physical Laboratory and University of Nottingham, UK*; P.J. Cumpson,* National Physical Laboratory, UK*; S. Allen, S. Tendler, P. Williams,* University of Nottingham, UK

Since its invention in 1986 the AFM technique has been a powerful imaging tool, and increasingly an instrument to measure forces of the order of pN to nN. These measurements are important in biological research in the context of the study of specific interactions that affect stability and biological function of macromolecules. The accuracy of those measurements relies largely on the determination of the AFM-cantilever spring constant. Several calibration methods have been developed based on different approaches ranging from dimensional measurements of cantilevers, or static loading to dynamic measurements and Finite Elements simulations. All these methods suffer from poor precision arising from different sources (limited manufacturing control in thickness and elastic properties, difficulties in dynamic modelling, etc) Here a different approach is tested, which doesn't rely on the study of the cantilever systems. All the difficulties concerning elastic constant calibration are "transferred" to a reference system, the Electrical Nanobalance device.@footnote 1@ This is designed as a MEMS device in order to provide accurate calibration of its spring constant by a combination of interferometrical measurements and electrical excitation in vacuum. Once calibrated the spring constant of cantilevers of different materials and geometries can be determined by comparison with the nanobalance device through a simple force-distance measurement performed in air. In this poster we present tests of Electrical Nanobalance MEMS devices, in particular examining the so-called corner-loading problem. @FootnoteText@ @footnote 1@ P J Cumpson and J Hedley, Nanotechnology 14 (2003) 1279-1288.

AS-MoP12 An Investigation of Photoperturbation Effects on Conductive Atomic Force Microscopy*, **M.-N. Chang**, C.-Y. Chen,* National Nano Device Laboratories, Taiwan

Conductive atomic force microscopy (C-AFM) with a high current sensitivity and a high spatial resolution has attracted much interest in mapping two-dimensional current distribution, investigating the local current-voltage characteristics and examining the breakdown properties of the dielectric layer in electronic devices. With atomic force microscopic setup, C-AFM can synchronously provide the current images and the corresponding topographic images. However, it has been revealed that the stray light of AFM laser beam can induce photoperturbations and hence lead to many difficulties in employing scanning capacitance microscopy to investigate carrier distribution and electrical junctions. In this work, we have qualitatively revealed that the AFM laser beam can significantly perturb the local current-voltage spectra and current distribution profiles taken by C-AFM. Studied samples were n- and p-type silicon covered with a thermally grown ultrathin SiO@sub 2@ film. The wavelength of the AFM laser ranges from 620 nm to 690 nm and the output power is 1.0 mW. The C-AFM measurement was performed in an environment with well-controlled temperature and humidity. For p-type sample, it is clearly observed that the onset voltage decreases with the photoperturbation level. The photovoltaic effect and the additional minority carrier density at the edge of the space-charge region can enhance the electric field across the SiO@sub 2@ film. For n-type sample, photoperturbations can lead to a higher injection barrier height for electrons. Experimental results indicate that the photoperturbations induced by the AFM laser beam not only significantly affects the current image of C-AFM, but also reduces the accuracy of the examination of the current-voltage characteristics, in particular for the ultrathin dielectric film on lower band-gap semiconductors, e.g., Si and Si@sub x@Ge@sub 1-x@.

AS-MoP13 Random Fractal Behavior of InGaAs Quantum Dots Using AFM*, **X. Qian**, S.R. Vangala, C. Santeufemio, W.D. Goodhue,* University of Massachusetts*; Y. Park,* Inje University, South Korea

Autocorrelation, height-height difference correlation, and power spectral density (PSD) analysis techniques have been applied to AFM scans of semiconductor materials for years. Recently Fenner et al@footnote 1@ and Krishnaswami et al@footnote 2@ have developed and applied random fractal analysis techniques to AFM image statistics in order to determine the fractal nature of semiconductor surfaces. Here random fractals are used to investigate InGaAs quantum dots. An uncapped single layer InGaAs dot structure exhibited an autocorrelation Hurst parameter of approximate 0.67 with an autocorrelation length of 90 nm and height-height difference correlation length of 56 nm. An uncapped InGaAs dot structure with two buried InGaAs dot layers exhibited an autocorrelation Hurst parameter of approximate 0.45 with an autocorrelation length of 70 nm and height-height difference correlation length of 47 nm. A 220 nm capped three layers InGaAs dot structure on the other hand exhibited an autocorrelation Hurst parameter of approximate 0.9 with an autocorrelation length of 190 nm and height-height difference correlation length of 130 nm. All samples exhibited height-height difference Hurst parameters and power spectral density Hurst parameters of 1 (indicating Gaussian distributions). All images analyzed were 10x10 µm@super 2@ in size. The analysis indicates that as more dot layers are incorporated in the structure, the fractal nature of the over layer increases. This nature is reversed by a thick capping layer. @FootnoteText@ @footnote 1@ D.B. Fenner, J. Appl. Phys., 95(10),5408-5418 (2004)@footnote 2@ K. Krishnaswami, Mater. Res. Soc. Symp. Proc. Vol.829 (2005).

AS-MoP14 Potential Difference Mapping of Molecules and Particles on Insulating Substrate*, **F. Yamada**, T. Matsumoto, H. Tanaka, T. Kawai,* Osaka University, Japan

A lot of research groups are challenging to fabricate molecular devices by using self-assembly of molecules. For this purpose, the knowledge of local surface potential is essential to understand and control the driving force of the self-assembly. However, it is very difficult to measure the electric properties of nano structures of the molecular devices because such devices are created on an insulating substrate. We report here surface potential measurement of DNA and nanoparticle on an insulating substrate. We used the frequency mode non-contact AFM (FM-ncAFM). NC-AFM is able to measure local electrostatic force with high sensitivity and NC-AFM prevents the charge injection induced by tip-sample contact. The measurement reveals that the potential of DNA is higher than mica and sapphire surface. In this experiment, we demonstrated that the NC-AFM enables us to obtain surface potential images of molecules on insulating substrates. We also measured the d(@DELTA@f)/dV images of DNA and Au nanoparticles on mica. We found that the plots of the d(@DELTA@f)/dV as a function of bias voltage give characteristic slopes indicating the dielectric constants of different absorbates. This result means that this measurement can be used to discriminate surface species on an insulating substrate. To discuss about the contrast mechanism of the surface potential imaging on insulating substrate, this result is beyond the understanding based on

Kelvin force microscopy because the surface potential of insulating substrate is indefinable. Then, we calculate electric filed just below the tip apex using finite element method. The calculation results reveals that the electric field just below the tip apex is enough strong to detect the local charge on surface adsorbate even if the substrate is insulator.

AS-MoP15 Surface Structure of Thermal Neutron Absorbing Ni-Cr-Mo-Gd Alloys, ***P.J. Pinhero***, *T.L. Trowbridge, T.E. Lister, R.E. Mizia,* Idaho National Laboratory

A new thermal-neutron-absorbing Ni-Cr-Mo-Gd alloy was developed at the Idaho National Laboratory (INL). The purpose of this alloy is to potentially absorb neutrons liberated from spent nuclear fuel (SNF) and mitigate any issues related to nuclear criticality. The microstructure of this alloy indicates a two-phase structure consisting of the primary Ni-Cr-Mo austenite matrix phase and secondary Ni@sub 5@Gd phase inclusions arising from the precipitation of the austenite-insoluble Gd. Presently, this alloy is under consideration for use within the U.S. Department of Energy (DOE) standardized SNF waste packages. To support the case for this alloyâ?Ts acceptance and understand its more fundamental surface character, studies were undertaken to examine its structure and composition with respect to its bulk properties, the role of oxidation and resulting passivation on its susceptibility to corrode, and finally how these properties are influenced through boron-doping. This paper focuses on the surface structure and composition of the Ni-Cr-Mo-Gd alloy, and its boron-doped brethren, through the use of electron microscopy, electron spectroscopy, and scanning probe microscopy.

AS-MoP16 Information Needed for Improving Sputter Depth Profiling, ***M.H. Engelhard***, *D.R. Baer, D.J. Gaspar,* Pacific Northwest National Laboratory

In a recent survey of needs for improving surface analysis conducted by ASTM Committee E42 on Surface Analysis, nine of the top twenty-five areas of need involved obtaining depth information. Analysts were interested in reference data, reference materials, and guides or protocols for obtaining useful information. Specific requests related to a data base containing relative sputter rates for compound materials and protocols for obtaining depth information for layered samples. Although not highlighted in the survey, accurate comparison of sputtered depths requires knowledge of the sputter rate reproducibility for a specific system before information about the relative sputter rates for different materials is meaningful. In this presentation we will present data on the reproducibility of sputter rates for our Phi Quantum 2000 and show data we have collected on the measured sputter rates for Fe@sub 2@O@sub 3@ and CeO@sub 2@ relative to SiO@sub 2@. We also note that many modern materials for which thickness information is desired are not simple thin films. We have found that apparent sputter rates for nanoporous silica films can be significantly altered (at least for a short term) by sample processing and cleaning methods.

AS-MoP17 Effect of Nitrogen on the Preparation of High Quality TiO@sub2-X@N@subX@ Thin Films as a Photocatalyst, *K. Prabakar, T. Takahashi,* ***T. Nezuka,*** Toyama University, Japan*; T. Nakashima,* Kashiwa Chuo High School, Japan*; Y. Kubota,* Yokohama City University, Japan*; A. Fujishima,* Kanagawa Academy of Science and Technology, Japan

Titanium dioxide (TiO@sub2@) has been a well-known photocatalytic material for the past few decades, but needs UV light, so the development of a photocatalyst sensitive in visible light irradiation condition is important for indoor use. The main approaches were substitutional doping of nitrogen, since the TiO@sub2-X@N@subX@ films absorbs visible light, we have decided to use the visible light active TiO@sub2-X@N@subX@ film for the development of photocatalysis under controlled deposition parameters. TiO@sub2-X@N@subX@ films were deposited on glass substrates by reactive magnetron sputtering with different Ar+O@sub2@ mixture (7:3, 8:2 and 9:1) as reactive gas at different nitrogen flow ratio. Interestingly, the absorbance spectrum of the TiO@sub2-X@N@subX@ revealed that that the amount of nitrogen doped in the TiO@sub2@ films is not influenced by the nitrogen gas flow ratio but greatly depends on the sputtering pressure and substrate temperature. The properties of the films, including crystallinity, surface morphology and light absorption capability are influenced by the sputtering pressure, substrate temperature and post deposition annealing. The absorption edge shift to the visible light region and the new absorption shoulder at around 430 nm were observed for the films deposited at 0.1 Pa and annealed at 400 ° C and that they were related to the nitrogen doping, since TiO@sub2@ does not absorb such visible light regions. The photocatalytic degradation of organic compounds were analyzed and discussed as a function of deposition parameters such as gas flow ratio, substrate temperature, sputtering pressures and source to target distance. The efficiency of the photocatalytic activity of the TiO@sub2-X@N@subX@ thin films are calculated at different light intensity, solution concentration and the results are discussed.

AS-MoP18 Sputtering Pressure Dependent Photocatalytic Properties of TiO@sub2@ Thin Films, ***T. Takahashi***, *K. Prabakar, T. Nezuka,* Toyama University, Japan*; T. Nakashima,* Kashiwa Chuo High School, Japan*; Y. Kubota,* Yokohama City University, Japan*; A. Fujishima,* Kanagawa Academy of Science and Technology, Japan

Titanium dioxide (TiO@sub2@) has been well-known as a photocatalyst. The objective of this research was to study the photocatalytic degradation of methanol and methylene blue at different light intensity and concentration by the effect of TiO@sub2@ thin film deposition parameters. The TiO@sub2@ films were deposited on glass substrate by direct current reactive magnetron sputtering under various total sputtering gas pressures (P@subS@) of 0.2, 0.5, 0.8 and 5 Pa and at the target to substrate distance (D@subT-S@) of 40 and 70 mm respectively with oxygen argon flow ratio 7:3 and 8:2 to find the optimum conditions to deposit the films with high photocatalytic activities. Structural factors dominating the photocatalytic activities were investigated in detail in relation to the sputter deposition processes. The films deposited at P@subS@ of 0.2 and 0.5 Pa and D@subT-S@ of 40 mm showed polycrystalline anatase structure, but, in the case of D@subT-S@ as 70 mm, only the film deposited at P@subS@ of 0.2 Pa showed the polycrystalline anatase structure. The films deposited at P@subS@ of 0.2 and 0.5 Pa showed decreasing tendency in the optical band gap energy and performed high photocatalytic activities. Such enhancement of the photocatalytic activity was considered to be correlated with the less number of defect level generations caused by the bombardment of the high-energy particles due to the long mean free path. The band gap energy was found to decrease from 3.4 to 3.1 eV for the TiO@sub2@ films deposited at lower P@subS@ as well as the D@subT-S@ was 40 mm, because of the higher crystallinity compared to the films deposited at high pressures and longer D@subT-S@. In addition to this, the films deposited at D@subT-S@ of 70 mm showed the decrease in density consequently increase in the optical band gap energy. The efficiency of the TiO@sub2@ catalysis was studied to evaluate the economic viability of this technique.

AS-MoP20 Development of a Plasma Process for Improving Optical and Biocompatible Properties of Contact Lens, *M. Dhayal, C.H. Kim,* ***C.H. So,*** Dongshin University, South Korea

The use of contact lenses is limited by its optical and biocompatible properties of materials and coatings used in the process. Therefore, a new process has been developed to improve the optical properties of contact lens materials with biocompatibilities. In this work the effect of different SiO2 and TiO2 coatings on polymeric or non polymeric material characterized for optical and biological properties. The TiO2 coatings has advantage in having low reflectance (<0.5 %) and on this coating on soft substrate materials (PMMA) can prevent from hard scratching, effect of temperature variation etc. The particular interest is in quarter wavelength thickness (100 to 200 nm) films of low reflectance for visible light wavelength (400 to 700 nm) having high optical uniformity, temperature stability, resistance to environmental and mechanical degradation. The optical properties of films (such as reflectance, refractive index) has been measured using optical spectrometer, XRD used to characterized the surface structure of films where as XPS used for surface sate analysis. Quality of composition and grain size of micro structure of coatings layer (surface) also examined using SEM, AFM.

AS-MoP21 UHV Studies of Silicon Carbide Gas Sensors with Catalytic Platinum Gates, ***Y.H. Kahng***, *R.G. Tobin,* Tufts University*; R.N. Ghosh,* Michigan State University

We have studied the sensing response and surface chemistry of silicon carbide (SiC)-based gas sensors with catalytic platinum gates, in ultrahigh vacuum. Silicon carbide's large bandgap (2.4 - 3.3 eV), native oxide, and rugged physical properties make it an attractive material for use in extreme environments, including corrosive gases and temperatures up to 1000 K. Possible applications include coal burners and gasification facilities. Catalytic-gate devices based on SiC have shown response to hydrogen and hydrogen-containing gases over a wide concentration range, but details of the transduction mechanism are not fully understood. We report UHV studies of the surface chemistry and sensing behavior of prototype Pt-SiO@sub 2@-SiC sensors, aimed at a detailed understanding of the role of the catalytic gate in abstracting hydrogen from the analyte, providing pathways from the gate surface to the oxide interface, and catalyzing

oxidation of hydrogen desorbed from interface sites. Issues investigated include sensor response to varying partial pressures of hydrogen and oxygen and changes in gate properties resulting from gas exposure at elevated temperatures (600 - 800 K). Because sulfur is a contaminant in most fossil fuels and a notorious poison for catalysts, effects of sulfur contamination have also been studied.

AS-MoP22 Electrochemical Spectroscopic Studies of New Materials for PEM Fuel Cells*, **P.C. Wong**, D. Susac, L. Zhu, A. Sode, M. Teo, D. Bizzotto, R. Parsons, K.A.R. Mitchell,* University of British Columbia, Canada*; S.A. Campbell,* Ballard Power Systems, Canada

A new approach for designing potential catalysts for proton exchange membrane (PEM) fuel cells involves characterizing surfaces of thin film materials fabricated as possible cathodes, to avoid the expense and slow oxygen reduction kinetics associated with platinum. This paper will describe studies, especially with X-ray photoelectron spectroscopy (XPS) and scanning Auger microscopy (SAM) of metal chalcogenide surfaces before and after electrochemical activity. Particular examples will be presented for thin films formed by cobalt and selenium, and the electrochemical behaviors will be related to the surface character of the different samples.

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