Functional Thin Films and Surfaces
Room Town & Country A - Session MB-ThP
Functional Thin Films and Surfaces Poster Session

MB-ThP-2 Scalable Surface Engineering of PDMS for Uniform Inkjet-Printed Silver Patterns*, Hsuan-Ling Kao [snoopy@mail.cgu.edu.tw],* Chang Gung University, Taiwan*; Li-Chun Chang,* Ming Chi University of Technology, Taiwan*; Min-Hsuan Lu,* Chang Gung University, Taiwan

The advancement of flexible and wearable electronics has increased the demand for materials compatible with the human body. Polydimethylsiloxane (PDMS) stands out due to its biocompatibility, transparency, chemical stability, and skin-like mechanical properties, making it suitable for bio-integrated devices. Its elastomeric nature also allows conformal contact with curved surfaces, making it suitable for epidermal and implantable electronics. Despite these advantages, achieving reliable inkjet printing of conductive traces on PDMS remains challenging due to poor ink adhesion and inconsistent droplet behavior. This study introduces a scalable surface modification approach using dielectric barrier discharge (DBD) plasma to improve PDMS wettability for inkjet printing of silver nanoparticle films. The DBD plasma treatment was performed under ambient conditions, and the discharge parameters were tuned to ensure uniform activation across the entire surface. The optimized argon flow rate and electrode gap facilitated consistent plasma exposure, resulting in reproducible surface energy enhancement. By optimizing argon flow and electrode-substrate distance, the treated area was expanded to 5 × 5 cm^2. Water contact angle (WCA) measurements across nine points confirmed uniformity, averaging 50° ± 1.8°, and white-light interferometry verified the surface remained undamaged. Substrate temperature was also found to play a role comparable to WCA in determining film quality, particularly in relation to printed pattern dimensions. At 50 °C, 200 µm-wide lines printed with three layers exhibited slight wrinkling or cracking, while 300 µm-wide lines showed minor edge spreading. Four-layer prints at this temperature led to bulging. At 60 °C, three- and four-layer 200 µm-wide lines suffered from severe wrinkling and cracking, while 300 µm-wide lines showed edge drying or bulging in three layers, and slight bulging in four layers. An appropriate substrate temperature was identified as essential, enabling both 200 µm and 300 µm-wide silver lines to maintain structural integrity and electrical performance across three to four printed layers. Under these optimized conditions, 300 µm-wide, 4 cm-long silver transmission lines exhibited excellent conductivity with low insertion loss. These results demonstrate the effectiveness of the proposed surface engineering and printing strategy for enabling high-quality, large-area conductive patterns on PDMS, supporting the development of next-generation bio-integrated electronic systems.

MB-ThP-4 Spatially Resolved Molecular Arrangement on the Surface of PEDOT:PSS Film via Laser Scanning*, Chanwoo Kim,* ***Habeom Lee [hblee@pusan.ac.kr],*** Pusan National University, Republic of Korea

Conjugated polymers, particularly poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS), are extensively studied for their intriguing electronic and optical properties, making them promising candidates for various functional applications. Precise and spatially resolved control over their molecular organization and morphology is one of challenging things for the tailored innovations. Here, we present a comprehensive investigation into the localized and spatially precise surface structural reorganization of PEDOT:PSS films, achieved through Laser-induced photo thermal effect without any chemical agents. Our focus is on delineating the intricate morphological and molecular changes and understanding the underlying mechanism that enables this spatial control.

Our study delineates the morphological evolution on surface of PEDOT:PSS films (~ 10 µm thickness) under varying laser doses (wavelength: 532 nm, spot size: 7 µm, continuous wave). Notably, a moderate laser dose induces significant morphological transformations, including undulating and dome-like micro-scale surface features with color change. Critically, the moving continuous laser induces a localized thermal distribution. This consistent thermal propagation, coupled with the kinetic state of the laser, induces a rearrangement within the PEDOT:PSS molecular system. The evidenced AFM phase images exhibit a distinct geometry, providing direct visual evidence of spatially controlled molecular reorganization on the surface. These observations promise a powerful approach for achieving spatially resolved control over molecular arrangement, enabling precise patterning and local property tuning.

Further characterization using XPS, UV-Vis, AFM, XRD, Raman, and FT-IR spectroscopy provides insights into the mechanisms driving these changes. This comprehensive study not only significantly elucidates fundamental understanding of laser-PEDOT:PSS interactions for functional film design but also suggests the intricate potential of this technique for creating advanced functional surfaces with tailored properties through precisely engineered molecular architectures.

MB-ThP-5 Influence of the Si Alloying on the Growth Stability and Electrical Properties of Aln Thin Films*, Norma Salvadores Farran [norma.salvadores@tuwien.ac.at], Tomasz Wojcik,* TU Wien, Austria*; Astrid Gies, Jürgen Ramm, Klaus Böbel,* Oerlikon Balzers, Liechtenstein*; Szilard Kolozsvári, Peter Polcik,* Plansee Composite Materials, Austria*; Tobias Huber, Jürgen Fleig, Helmut Riedl,* TU Wien, Austria

Aluminum nitride-based ceramics are well known for their insulating properties combined with high thermal conductivity. Their range of applications is wide, in both structural components and thin films. However, the electrical conductivity of these materials is highly temperature-dependent. As the temperature increases, the mobility of charge carriers also rises, which poses significant challenges to their insulating performance.

This study investigates the growth of insulating AlSiN thin films using physical vapor deposition (PVD) and evaluates their electrical insulation at temperatures up to 750 °C. Various reactive PVD techniques were explored, including high-power impulse magnetron sputtering (HiPIMS) and bipolar pulsed sputtering. All depositions utilized a 3-inch aluminum target with varying silicon concentrations in an Argon/Nitrogen (Ar/N_2) atmosphere. Depending on the silicon content, either hexagonal AlN films containing an amorphous Si_3N_4 phase or fully amorphous AlSiN films were produced. The target's alloying concept was designed to enhance deposition stability during sputtering. Within this framework, we also investigated the formation of a fully nitride film at lower reactive gas ratios while maintaining excellent electrical insulating properties.

Phase formation has been examined using X-ray diffraction (XRD), while the deposition rate and film morphology were characterized by scanning electron microscopy (SEM). The insulating behavior of the coatings was evaluated via in-situ impedance spectroscopy across a temperature range from 300°C to 750°C, using Ti/Pt lithography pads as electrodes.

The electrical properties are related to the morphology of the films, particularly whether the films were crystalline or amorphous. Additionally, the influence of impurities, such as O_2, plays a significant role in reducing the insulating properties of the films.

MB-ThP-8 Different Morphologies of Gallium Oxide Thin Films Fabricated by Liquid-Target Reactive DC-Pulsed Magnetron Sputtering*, Jan Koloros [koloros@ntis.zcu.cz], Petr Novák, Sayed Alireza Ataie, Jiří Rezek, Radomír Čerstvý, Pavel Baroch,* University of West Bohemia in Pilsen, Czechia

Gallium oxide (Ga_2O_3) remains a focus of research due to its outstanding optoelectronic properties, including an ultra-wide bandgap of approximately 4.8 eV, a high electron saturation velocity, and its ability to withstand a high breakdown electric field of about 8 MV/cm. Although Ga_2O_3 is typically prepared using methods such as MBE, MOCVD, or ALD, it would be advantageous to find a viable method for preparing this material using magnetron sputtering as well. This is because this method is known for its high deposition and ease of up-scaling the process. Despite some published work in this area, it has not yet been possible to find conditions that lead to layers with satisfactory electrical properties.

In this work, we focus on reactive magnetron sputtering of Ga_2O_3 films using a liquid gallium metal target on different substrates and under various conditions (oxygen and argon partial pressures, substrate temperature, and pulse-averaged target power density). The resulting films exhibit a broad range of morphologies, from compact solid thin films to wire-like microstructures. We present the optical, electrical, and microstructural properties of the films and suggest their correlations with the discharge parameters as well as the substrate used. We found that the crystalline quality of Ga_2O_3 films and their preferential orientation play a crucial role in achieving improved electrical properties. The optimal crystal structure can be obtained primarily by selecting an appropriate temperature and substrate that promotes the crystalline growth of the film.

MB-ThP-10 3-Layer Polymer Film Composites Based on PE Recyclates*,*
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Keywords: n-layer films; blow molding; polymer composites; recycling; hot-tack

Multilayered films are used recently for many applications like packaging, materials with special barrier properties or with resistance for specific liquids or radiation, e.g. UV. The investigation aimed to obtain the composite in form of 3-layer polymer film and nextly to perform the analysis of the structure and properties of newly developed composite produced using 20 meter high blow moulding technology supported by a precision gravimetric dispensing system. To keep better control, the process was supported by advanced, rotating basket and precise sensors. The film samples were prepared, including a reference film labelled as PE pure and made from standard material, and films with a modified middle layer B, containing regranulate and calcium carbonate in specified proportions. The mechanical strength tests of the sealed films were conducted to verify strength of films in aim to be used for FFS (Form-Fill-Seal) packaging lines and are very promising comparing to single layer films. 3-layer packaging films based on PE recyclates and calcium carbonate in the middle layer, retain their required mechanical properties.

MB-ThP-11 Plasma-Polymer Fluorocarbon Based High Sensitivity Surface Enhanced Raman Spectroscopy Application*,*
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Surface-enhanced Raman spectroscopy (SERS) provides a powerful analytical tool for molecular identification through the amplification of Raman scattering signals from target analytes on plasmonic nanostructures. In this study, we present a plasma–polymer–fluorocarbon (PPFC)-based nanocomposite thin-film platform designed to achieve high SERS sensitivity via controlled nanoparticle formation. By tuning the sputtering power density during mid-frequency magnetron sputtering, the distribution and ratio of Ag and Cu nanoparticles embedded in the PPFC matrix were precisely modulated, as confirmed by X-ray photoelectron spectroscopy (XPS) and ultraviolet–visible–near infrared (UV–Vis–NIR) spectroscopy. The optimized Ag–Cu PPFC (CAP) thin films exhibited distinct localized surface plasmon resonance (LSPR) absorption peaks and demonstrated an enhancement factor (EF) of up to 10^8 for rhodamine 6G, supported by finite-difference time-domain (FDTD) simulations showing strong electromagnetic localization at the metal–metal nanogaps. Furthermore, a simplified fabrication approach employing a single composite target of Cu, carbon nanotube (CNT), and PTFE powders (5:60–80:35–15 wt.%) was developed to produce Cu–PPFC nanocomposite films with moderate SERS sensitivity (EF ≈ 2.18×10^4). The prepared CAP and Cu–PPFC nanocomposite films successfully detected rhodamine 6G on flexible polyethylene terephthalate substrates, maintaining distinguishable Raman signals even with reduced optical transmittance. These results demonstrate that plasma–polymer fluorocarbon nanocomposites incorporating Cu and Ag nanoparticles offer a scalable, flexible, and cost-effective route toward high-performance SERS-active substrates suitable for on-site and point-of-care molecular detection applications.

MB-ThP-12 Radio Frequency Magnetron Sputtered CdS-Plasma Polymerized Fluorocarbon Nanocomposite Thin Films : Structural Properties and Electrochemical Performance for Lithium-Ion Battery Anodes*,*
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Radio Frequency (RF) magnetron sputtering was employed to synthesize CdS–plasma polymerized fluorocarbon (PPFC) nanocomposite thin films. This work presents a comprehensive analysis of the structural, chemical, and morphological characteristics of these films, followed by an evaluation of their potential as anode materials for lithium-ion batteries.

Advanced characterization techniques, including Transmission electron microscopy (TEM), X-ray diffraction (XRD), grazing incidence small-angle X-ray scattering (GISAXS), and X-ray photoelectron spectroscopy (XPS), were utilized to elucidate the film properties. These analyses confirmed the successful incorporation of CdS nanoparticles within the polymeric matrix as shown in **Figure 1**.

Electrochemical testing demonstrated that the CdS–PPFC nanocomposite thin films exhibit stable performance as battery anodes. Notably, thinner films displayed superior battery performance compared to thicker electrodes. This enhancement is attributed to the evolution of surface morphology; specifically, a reduction in film thickness leads to increased surface roughness, which in turn provides a larger surface area for electrochemical reactions.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government(MSIT) (RS-2025-00516639)

MB-ThP-13 Synthesis of Bismuth Molybdate Photocatalytic Films by Reactive Magnetron Sputtering for the Photo-Discoloration of Carmine Indigo Dye*,*
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Water pollution has increased significantly due to rapid industrial growth. A significant issue arises from dyes produced by various industries, including the chemical, medical, leather, and other sectors, which pose significant environmental impacts due to their difficult disposal. Photocatalysis has recently attracted considerable attention and demonstrates significant promise for the degradation of diverse organic and inorganic contaminants. It is considered one of the most sophisticated advanced oxidation methods for removing an extensive variety of organic and inorganic pollutants. Bismuth molybdates (BMO) are photocatalytic semiconductors employed in potential applications including water pollutant degradation, air purification, and carbon dioxide reduction, among others.In this work, we report on the synthesis, morphological, structural, compositional, and optical characterization, as well as the evaluation of the photocatalytic response of BMO in thin-film form. The films were produced through co-deposition by sputtering from two independent targets: bismuth oxide (α-Bi_2O_3) and molybdenum (Mo). This approach allows precise control over composition and the attainment of various phases without the need to fabricate targets with different compositions. The deposits were produced by maintaining a constant power of 30 W on the α-Bi_2O_3 target while varying the power on the Mo target from 20 to 100 W. The substrates were heated to 150 °C during deposition, followed by a 1-hour heat treatment at 500 °C in air to induce crystallization. The phases observed were determined by X-ray diffraction and Raman spectroscopy, while their optical properties, specifically the band gap, were estimated using UV-Vis reflectance spectroscopy.The photocatalytic response of the films was evaluated by photodecolorization of indigo carmine (IC) dye solutions at five ppm and pH 3.5 under irradiation from a 385 nm light source. The results showed a decrease in the intensity of the 610 nm absorption band of the IC solution with increasing irradiation time, achieving almost 100% photodecolorization in approximately 2 hours. Subsequent tests for reuse and stabilization were performed for practical applications, repeating the IC blue photodegradation experiments ten times using the sample that showed the best photocatalytic performance. No significant reduction in photocatalytic activity was observed after 10 cycles of testing.

MB-ThP-14 Microstructure and Electrochemical Behavior of Aps Coatings Deposited on Agricultural Plows*,*
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This research focuses on the application of thermal spray technologies aimed at optimizing the functional properties of agricultural components intended for soil tillage. The investigation is based on thermal coatings obtained through Atmospheric Plasma Spray (APS) technology applied to the constructive elements of agricultural ploughs, which are subjected to aggressive operating conditions. The specific properties of these components—microstructural analysis and corrosion resistance—constitute determining parameters for ensuring enhanced durability of agricultural equipment (mainshare and foreshare).

Within the experimental investigation, protective coatings were deposited through thermal spray technology using metallic powders based on WC12%Co (commercial designation WOKA 3101). Characterization of the microstructural properties and electrochemical behavior of the deposited layers was evaluated on laboratory specimens in specific corrosion environments. The obtained results demonstrated that thermal spray coatings presents an optimal method for enhancement and potential reconditioning of components.

The deposited layers exhibited satisfactory adhesion and characteristic microstructure, composed of successive splats with reduced porosity. Analysis of electrochemical behavior revealed superior corrosion resistance compared to the base material, an aspect indicating significant improvement of functional properties and enhanced functional capacity of the coated components.

Acknowledgment: This work was supported by a grant from the Ministry of Education and Research, CCCDI–UEFISCDI, project number PN-IV-PCB-RO-MD-2024-0336, within PNCDI IV

MB-ThP-15 Influence of Microstructure on Dealloying Kinetics of Nanoporous Thin Films*, Ezgi Hatipoğlu,* Max Planck Institute for Sustainable Materials, Germany*; Ayman El-Zoka,* Imperial College London, UK, Germany*; Yujun Zhao,* Max Planck Institute for Sustainable Materials, Germany*; Stanislav Mraz, Jochen Schneider,* RWTH Aachen University, Germany*; Baptiste Gault,* ***Aparna Saksena [a.saksena@mpi-susmat.de]**,* Max Planck Institute for Sustainable Materials, Germany

Nanoporous metals offer an important platform for tailoring composition and surface-to-volume ratio, both aspects critical for applications in catalysis where nanoporous thin films can offer further ease of handling. These films are however prone to intergranular cracking during dealloying, limiting their stability and potential applications. Here, we set out to systematically investigate the grain boundaries (GBs) in Au28Ag72 (± 2 at.%) thin films. We observe that sample synthesized at 400 °C is at least 2.5 times less prone to cracking compared to sample synthesized at RT. This correlates with a higher density of coincident site lattice (CSL) GBs, especially the density of Σ3, increased, which appear resistant against cracking. Atom probe tomography (APT) of random high-angle GBs reveals prominent Ag enrichment of up to 77at.%, whereas Σ3 coherent twin boundaries show Au enrichment of up to 30at.%. APT also reveals a strong texture dependence on the dealloying kinetics where the (111)-textured film retains a higher Ag concentration within the nano-ligaments and the untextured film already exhibits coarsening, indicating a faster reaction kinetics, and a lower Ag content. Our study highlights the potential of microstructure engineering in tailoring the properties of nanoporous metals for possible future catalytic and electrochemical applications.

MB-ThP-17 Effect of UHTC Nanoparticle-Reinforced Micro Arc Oxidation Composite Coatings on the Surface Performance of Al 2024 Alloy*,* *Suleyman Sukuroglu,* ***Ebru Emine Sukuroglu [eesukuroglu@gumushane.edu.tr]**,* Gumushane University, Turkey

Aluminum (Al) and its alloys are widely used as structural materials in various engineering applications, particularly in the automotive, aerospace, and space industries, due to their high strength-to-weight ratio, corrosion resistance, high machinability, and superior specific strength. Despite these advantages, their relatively low surface hardness, high friction coefficient, limited wear resistance, and poor corrosion performance in aggressive environments restrict their application range. To overcome these drawbacks and expand the usability of Al and its alloys, surface modification processes have been extensively applied.

Micro Arc Oxidation (MAO) is an environmentally friendly coating technique that enables the formation of hard, strongly adherent ceramic oxide coatings on aluminum and its alloys. The aluminum oxide (Al_2O_3)-based ceramic coatings produced by this method significantly enhance the mechanical, tribological, and corrosion resistance of the substrate material. However, prolonged exposure of Al_2O_3-coated substrates to aggressive service environments may lead to coating degradation and deformation.

To mitigate these limitations and to tailor the mechanical, adhesive, and corrosion-resistant properties of the coatings, the incorporation of nanoparticles into the MAO electrolyte has emerged as an effective approach. Among these additives, ultra-high-temperature ceramic (UHTC) materials exhibit exceptional hardness, wear and corrosion resistance, and outstanding stability under extremely high-temperature conditions, making them highly promising for advanced aerospace and space applications. Artificially synthesized ceramics such as hafnium carbide (HfC) and zirconium carbide (ZrC) are among the materials with the highest known melting temperatures and are extensively utilized in extreme environments, including hypersonic systems, missile and rocket components, and thermal protection structures.

In this study, composite coatings reinforced with two different ultra-high-temperature ceramic nanoparticles, HfC and ZrC, were fabricated on Al 2024 alloy using the MAO method. The effects of these composite coatings on the structural, mechanical, tribological, and corrosion properties of the alloy were systematically investigated.

MB-ThP-18 Ion-Beam Assisted Deposition of Oxide Semiconductor Thin Films for Optical Devices*,* ***Pin Yao Hsiang [hsiangpy@gmail.com]**,* Chang Gung University, Taiwan*; Tsung Yu Huang,* Ming Chi University of Technology, Taiwan, Republic of China

This study investigated the use of a tin-based oxide (SnOx) semiconductor layer as the active layer for a light-addressable potentiometric sensor (LAPS) on a commercial indium tin oxide (ITO)/glass substrate. We characterized the optical absorption properties of the SnOx layer, as well as changes in Hall mobility and Raman spectroscopy, using ion beam assisted discharge (IBAD) and varying argon/oxygen flow ratios. The experimental results demonstrate the potential of SnOx as an active layer for LAPS, but the stability and lifetime performance of SnOx LAPS require further process optimization.

MB-ThP-19 Insulation Coatings for Temperature Sensors in Molding Tools*,* ***Martin Welters [welters@kcs-europe.com]**, Rainer Cremer,* KCS Europe GmbH, Germany

The mobility sector is one of the largest emitters of greenhouse gases. Consequently, providers of mobility services and systems are facing a profound transformation towards climate neutrality. A key lever on the path to emission-free production is circular value creation, which significantly reduces the use of primary raw materials and thus lowers environmental impact. The overarching goal of the project is to improve the CO_2 and environmental performance of structural and hybrid components by consistently increasing efficiency, using recyclates, and implementing an ecologically optimized component design.

One sub-project focuses on the development and design of sensor-equipped tool inserts for **in-situ temperature measurement**during the production of automotive components made from recycled materials. The sensor layer system consists of multiple layers - sensor layers and an electrical insulation and a wear-protection layer - applied on top of each other to form a layer stack. A key requirement is that the coatings must meet not only the sensory specifications but also the durability criteria necessary for their application - particularly when used with polymer melts containing recyclate components. For the development of the insulating layer, special sensor dummies as well as fixturing for PVD processes were developed to enable the investigation of local differences in the properties of the insulating layer. In this way, the aluminum-based insulation layers used could be iteratively improved with regard to the application, eliminating the need to coat numerous elaborately manufactured sensors.

MB-ThP-20 Corrosion-Inhibiting, Antibacterial Coatings for Soft Tissue Anchors*,* ***Simon Cremer [simon.cremer@kcs-europe.com]**, Rainer Cremer,* KCS Europe GmbH, Germany

Conventional biodegradable soft tissue anchors are exposed to severe corrosion due to their contact with blood, causing them to lose their integrity after only 8-12 weeks. PVD coatings are aimed at specifically influencing this corrosion. PVD coatings have long been studied for their corrosion protection properties. Although layers deposited by magnetron sputtering or arc evaporation nowadays have a dense microstructure. However, contact with corrosive media such as blood usually leads to pitting corrosion very quickly, which severely attacks the substrate materials underlying the coating. Such attacks occur primarily at layer growth defects.

In order to prevent controlled degradation of the implants and the negative effects of pitting corrosion, which manifests itself in excessively rapid corrosion, round samples of an Fe-Mn alloy were polished and coated with a thin titanium layer by KCS Europe using a sputtering process. To obtain an antibacterial surface, the samples were coated with a silver layer of 3, 10, and 30 nm in a second coating process. The thickness of the silver layer is decisive for the antibacterial effect of the surface. If the silver layer is too thin, the antibacterial properties of the surface can be lost because individual areas of the surface are not coated. A continuous silver layer, on the other hand, prevents the desired controlled degradation of the implants. A surface on which individual silver cells were deposited locally in island-like formations, but did not completely cover the substrate, proved to be optimal for controlled decomposition and the antibacterial effect of the coatings.

MB-ThP-21 Partial Laser Ablation in PVD Multilayers for Multicolored and Nanostructured Surfaces, *Raphael André,* Berner Fach Hochschule, Switzerland; *Christian Petitot,* Université Marie et Louis Pasteur, UTBM, CNRS, Institut FEMTO-ST (UMR 6174), France; *Rainer Kling, Sylvain Le coultre,* Berner Fach Hochschule (BFH), Switzerland; ***Pascal briois [pascal.briois@utbm.fr]***, Université Marie et Louis Pasteur, UTBM, CNRS, Institut FEMTO-ST (UMR 6174), France

The APLM (*Ablation Partielle par Laser dans des Multicouches PVD pour des surfaces Multicolores et nanostructurées in french*) project is supported by the INTERREG VI France–Switzerland 2021–2027 program. The project consortium consists of two universities, namely the Bern University of Applied Sciences (BFH) and the University of Technology of Belfort-Montbéliard (UTBM), as well as four industrial partners (Plasmadiam and Gravity for Switzerland, and SILSEF and SAIREM for France).

The objective of APLM is to develop all the technical expertise required to industrialize a process invented and patented by BFH and Plasmadiam in May 2024. The invention combines vacuum deposition technologies for ultrathin coatings using PVD and PECVD, together with partial ablation by means of nanosecond, picosecond, and femtosecond pulsed lasers, enabling the generation of cavities within multilayers with nanometric control and precision. Prototypes of multicolored watch dials, as well as molds for nanoimprint lithography (NIL), embossing, and plastic injection molding, will be produced. These prototypes will help promote the technology and enhance the value of the invention, generating economic benefits for all industrial partners of the consortium within the regions and beyond.

The main actions of the project consist in developing various robust processes for depositing brightly colored layers or layers with specific optical properties by combinatorial PVD sputtering, with or without the use of MW-PECVD plasma, while meeting the mechanical specifications required for the targeted applications. Subsequently, a database of laser ablation thresholds (in J/cm^2) will be established for the different colored or functional PVD layers produced (20–500 nm thickness range) at different wavelengths. A predictive model will also be designed to estimate the ablation threshold of a material based on its physical properties. Finally, flagship prototypes demonstrating the patented technology will be developed in the fields of multicolored watch dials and nanostructured molds for NIL, embossing, and plastic injection, through the ablation of nanometric cavities structured on three or four levels.

During this poster presentation, a general overview of the project will be provided, along with a presentation of the first colored coatings obtained by BFH and UTBM. These coatings were produced by reactive magnetron sputtering.

MB-ThP-23 Numerical Modelling for Optimized Experimental Design in Vernier Ellipsometry Sensing, *Kawshik Shikder, Zhang Yun, Md Rashedul Huqe, Yishu Foo, May Thawda Phoo, Yee Man Kwong,* ***Juan Antonio Zapien [apjazs@cityu.edu.hk]***, City University of Hong Kong

In Vernier Ellipsometry Sensing (VES) two zero-reflection points (ZRPs) in p-pol and s-act in synergy to enable a refinement optical measuring scale akin to a Vernier scale. These new class of sensors are enabled by: i) strong coupling between p-pol surface plasmon polariton and p-pol photonic waveguide leading to Rabi splitting with phase singularities of the resulting hybrid resonances; ii) spectrally overlap between the s-pol photonic modes and the hybrid p-pol resonances; and, importantly, iii) the ellipsometric sensing strategy where the s-pol ZRPs provide a stable reference to boost the sensor performance in terms of the amplitude ratio and phase difference of both ZRPs.

In VES fine angle of incidence (AoI) tuning enables resetting the sensor to its optimal sensing point.We will present new numerical simulations that are able to track the performance of this VES with high efficiency to determine the optimum operation conditions in terms of (AoI) and spectral overlap resonance for la large dynamic range in changes of refractive index unit (RIU) in the sensing media. We discuss the implications of these results for the design of a dedicated AoI- and wavelength- resolved ellipsometer system capable to instantaneously track the best-point sensitivity and achieve lowest limit of detection (LoD) and large dynamic range.

MB-ThP-24 Selective Etching of Boron Doped Si1-XGeX Epitaxial Layers for Vertically Stacked Memory Device, ***Joosung Kang [jws1204@yonsei.ac.kr]***, *Dongmin Yoon, Seonwoong Jung, Dae-hong Ko,* Yonsei University, Republic of Korea

Dynamic random access memory (DRAM) devices have continuously increased their integration density through aggressive device scaling and have progressively evolved toward three-dimensional (3D) architectures to overcome the limitations of planar designs. Among various approaches, 3D DRAM structures employing highly stacked Si channels and SiGe sacrificial layers are regarded as promising candidates for cell designs beyond the $4F^2$ node. In such vertically stacked channel architectures, the selective removal of SiGe sacrificial layers from epitaxial Si/SiGe multilayers represents a critical process requirement.

In this study, the selective etching behavior of boron-doped SiGe epitaxial layers—introduced to compensate for strain arising from lattice mismatch between Si and SiGe—was systematically examined as a function of boron concentration. Dopant-dependent variations in etching behavior were observed in both blanket films and Si/SiGe multi-stack structures. To gain insight into the underlying mechanisms, the chemical bonding states of etched SiGe surfaces were analyzed using X-ray photoelectron spectroscopy (XPS), with a focus on dopant-induced modifications of oxide-related surface chemistry. The results reveal that boron incorporation significantly alters the etching response of SiGe layers through changes in surface oxide chemistry, leading to distinct dopant-dependent trends. These findings provide fundamental insight into dopant-mediated surface reactions during selective etching and offer useful considerations for process optimization in vertically stacked semiconductor device fabrication.

Acknowledgment

This work was supported by the Technology Innovation Programs (RS-2024-00434624 & RS-2025-02306457) and the K-CHIPS program (25065-15FC) funded by the Ministry of Trade, Industry & Energy (MOTIE, Korea).

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