Thin Films and Surface Modification
Room Naupaka Salon 4 - Session TF1-MoE

Thin Films - Materials I

Moderator: Ryo Toyoshima, The University of Tokyo

5:40pm **TF1-MoE-1 Plasma Diagnostic-Based Plasma Processing for Semiconductor and Nanomaterial Manufacturing**, ***Hyo-Chang Lee,*** Korea Aerospace University, Republic of Korea **INVITED**

Plasma has been actively used in semiconductor and nanomaterial manufacturing. As the structures of nanostructures and semiconductor devices become more complex, plasma process technology based on plasma characteristic measurement is needed. In this invited talk, several key plasma process results, including analysis of the correlations between process results and plasma variables, are presented.

6:20pm **TF1-MoE-3 Tailoring High Temperature Anti-Oxidizing Coatings by Sol-Gel Chemistry for Enhanced Aeronautic Efficiency**, *L. Lager,* University Lyon 1, France*; S. Senani-De Monredon, J. Delfosse,* Safran Tech, France*; S. Benayoun,* Ecole Centrale de Lyon, France*; **Berangere Toury,*** University Lyon 1, France

Reducing polluting gases emissions is a major strategic challenge for the aeronautic industry. Two approaches exist to achieve this : increasing engine operating temperatures and/or reducing the total mass of the aircraft. Titanium alloys, due to their low density, good damage tolerance, and excellent fatigue resistance, are particularly attractive for use up to temperatures of 500°C.

To date, the scientific challenge concerning these alloys is to extend their operating temperature resistance up to 600-700°C while maintaining or improving their specific properties required for the aimed application. One of the main causes of degradation in these alloys when used at high temperatures is related to oxidation. Actually, for these materials, oxidation can occur in two distinct ways : firstly, the formation of an external oxide layer (TiO_2), and secondly, significant oxygen diffusion within the underlying alloy. This second phenomenon is linked to the high solubility of oxygen in titanium. In both cases, without additional protection, the use of titanium alloys at high temperatures considerably reduces their mechanical properties, especially ductility.

In this context, the main goal of this study is focused on the design, synthesis and characterization of a high temperatures anti-oxidizing coating based on rare earth aluminate for enhanced titanium alloys used in aeronautics. In this work, we are interested in the synthesis of protective coatings by using the sol gel process, which is a versatile method allowing direct enduction of the sol on metallic substrates. Thus, leveraging precise control over sol chemistry enables the reach of coatings with desired stoichiometry. The morphology of the coatings is meticulously examined via SEM. Additional characterizations utilizing XPS, solid NMR, and thermal analyses where used to understand curing mechanisms. Initial oxidation tests reveal promising prospects for the application of these coatings in aeronautic contexts, potentially enhancing engine efficiency while mitigating environmental impact.

6:40pm **TF1-MoE-4 Fabrication and Characterizations of Aluminum Doped Cadmium Oxide (Cdo:Al) Thin Film Using Sol-Gel Spin-Coating Method**, ***Moniruzzaman Syed****, J. Massey, M. Hurd,* LeMoyne Owen College*; M. syeda,* University of Memphis

Aluminum-doped cadmium oxide (CdO:Al) thin films are deposited on silica substrates by the sol–gel spin-coating method as a function of spin coater's rpm (revolution per minute). Cadmium acetate dihydrate and Aluminum nitrate have been taken as the precursor material and a source of Al-dopant respectively. CdO:Al thin films are characterized by x-ray diffraction (XRD), Fourier Transform Infrared (FT/IR), Field emission scanning electron microscopy (FE-SEM) and SEM-EDX. XRD result indicates the highest crystallinity at 6000 rpm with a crystallite size of 31.845 nm, cubic phase formation, and strain of ~1.6 $X10^{-2}$. FE-SEM/SEM/EDX shows the well-faceted homogeneous surface structure at 6000 rpm having an average particle size of 130.05 nm. FT/IR confirms the presence of CdO:Al in the film with the peak position shifting to higher wavenumbers.

7:00pm **TF1-MoE-5 Structural and Electronic Impact on Various Substrates of Tio2 Thin Film Using Sol-Gel Spin Coating Method**, ***Afrika Leiws****, T. Crosby, J. Muhammad,* LeMoyne Owen College*; M. Syeda,* University of Memphis*; M. Syed,* LeMoyne Owen College

Titanium dioxide (TiO_2) thin films have been deposited on Corning 7059 glass and Fused quartz silicate substrates using the Sol-Gel spinning coating technique. On glass substrates, there are four Raman active bands are observed: 3Anatase [A<149cm-1>, A<523cm-1> and A<646cm-1>] and 1 Rutile B<401 cm-1>. On silica substrates, additional two more bands which are R<859 cm-1> and B<1068 cm-1> detected. The deposited films show polycrystalline nature with high XRD intensity peaks in (110), (200) and (211) orientation corresponding to anatase and rutile phases respectively with tetragonal BCC structure. The other orientations (101), (111), (210), (211), (220), (201), (002), (204) and (116) are also observed for all films with low intensities. XRD crystal sizes are found to increase with increasing annealing temperature on both substrates. Maximum crystal sizes are found to be ~31 nm on silica substrates and ~23 nm on glass substrates at 500oC. On glass substrate, TiO_2 thin film shows the agglomeration of various non-uniform flaky type of structures. On silica substrate, the FESEM micrographs show the following observations: (i) particles are spherical in shape with forming different islands (ii) particles are soft agglomerates/spongy in nature with uniform surface, (iii) each spherical agglomerate contains many particles in the nanometric range and (iv) the agglomerate size is in between 40 and 110 nm. FE-SEM TiO_2 particles size distribution at 500oC showed that the average particle size is 89.55 and 110.35 nm on glass and silica substrates respectively.

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