Special Interest Talks
Room Town & Country A - Session SIT1-MoSIT

Special Interest Session I
Moderator: Samir Aouadi, University of North Texas, USA

1:00pm **SIT1-MoSIT-1 From High Temperature Tribology to Ultrasensitive Biomolecular Detection: The Versatility of Transition Metal Dichalcogenide Thin Films***, **Christopher Muratore (cmuratore1@udayton.edu)**,* Department of Chemical and Materials Engineering, University of Dayton, USA **INVITED**

You can look through the program for this and many other conferences and see talks on MoS_2 and other transition metal dichalcogenides (TMDs) throughout diverse symposia .The extraordinary properties of TMDs are highly anisotropic, so most members of this family of materials are actually like two remarkable materials in one. TMDs demonstrate extremely low shear strength in one direction, and are quite strong in the perpendicular direction. The same can be said for thermal and electron transport properties. These differences arise from types of chemical bonding within a TMD crystal, and also give rise to anisotriopic catalytic properties and chemical reactivity in general. If the thickness of a TMD material is reduced to a few molecular layers, it has completely different optical and electronic properties than its bulk counterpart, with changes in the nature of the bandgap (indirect to direct, or vice-versa) in addition to extreme mechanical flexibility allowing strains greater than 10%.The chemical reactivity and other properties of many TMDs are well-suited for many biological applications, especially biomolecular sensing. To complete the portfolio of desirable attributes of TMDs, some have great natural abundance, with a price close to that of dirt. Some potential applications for stacks of ultra-thin, or two-dimensional (2D) TMDs (less than 5 molecular layers thick) have captured the imagination of materials scientists as a means of creating crystals layer-by-layer with tunable properties and without constraint on lattice parameter matching. The primary barrier for realization of custom crystals is the challenge of processing multilayer materials without introducing property-attenuating defects. Most frequently, multilayer van der Walls stacks entail materials removal and transfer methods from the growth substrate, which is challenging to scale. We have developed a novel approach to obtain van der Waals materials with over 100 individual, chemically distinct layers. To accomplish this, continuous sub-nanometer metal layers are sputtered on oxide substrates as a precursor phase for subsequent reaction in chalcogen gases for conversion to metal selenides or sulfides. To conquer physical limitations inhibiting continuous thin metal layers, the power to the sputtering source was optimized to deposit such thin layers without island formation. Selection of processing temperature allows orientation of reacted van der Waals layers horizontally or vertically. With this novel approach, rapid realization of the new physics promised for over a decade by development of monolayer TMD materials and their heterostructure superlattices is now underway.

Tuesday Evening, May 24, 2022

Special Interest Talks
Room Town & Country A - Session SIT2-TuSIT

Special Interest Session II

Moderator: Samir Aouadi, University of North Texas, USA

7:00pm **SIT2-TuSIT-1 Evaluating Electro-Mechanical Reliability using In-Situ Methods***, Megan J. Cordill (megan.cordill@oeaw.ac.at),* Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, Leoben, Austria **INVITED**

Electrical, mechanical and interfacial properties of thin metal films on compliant polymer substrates are important to understand in order to design reliable flexible electronic devices. Thin films of Cu, Au, and Al on polyimide (PI) substrates were examined for their use as interconnects in flexible electronic devices. Using in-situ tensile straining with atomic force microscopy (AFM), X-ray diffraction (XRD), and confocal laser scanning microscopy (CLSM) mechanical and interfacial behavior can be examined. AFM and CLSM can provide information about crack spacing and film delamination, while XRD experiments are utilized to determine the lattice strains and stresses present in the films. If these in-situ techniques are combined with in-situ 4-point-probe (4PP) resistance measurements, the influence of the mechanical damage on the electrical properties can be correlated. This combination of multiple in-situ investigations are particularly useful when studying the electro-mechanical behavior under cyclic loading conditions where some materials can have an improvement of the electrical conductivity after a few hundred cycles. Mechanisms behind these phenomena as well as methods to measure the adhesion of metal-polymer interfaces found in flexible electronic devices will be discussed.

Wednesday Afternoon, May 25, 2022

Special Interest Talks
Room Town & Country A - Session SIT3-WeSIT

Special Interest Session III
Moderator: Samir Aouadi, University of North Texas, USA

1:00pm **SIT3-WeSIT-1 Tribological Coating Solutions and Lubrication Strategies for Gas Turbine Engines***, Pantcho Stoyanov* ***(pantcho.stoyanov@concordia.ca)****,* Concordia University, Canada **INVITED**

The advancement of durable gas turbine engine components depends heavily on the development of high-performance materials, which can withstand extreme environmental and contact conditions (e.g. large temperature ranges, high contact pressures, and continuous bombardment of abrasive particles, all of which degrade the physical properties). In particular, due to the large number of complex contacting and moving mechanical assemblies in the engine, the lifetime of certain structures is limited by the tribological performance of the employed materials and coatings. This talk will provide an overview of tribological solutions and lubrication strategies employed in several sections of gas turbine engines. After a general review of aircraft engine tribology, the talk will focus on tribological coatings and materials used to minimize fretting type of wear. A series of studies on the friction and wear behavior of Ni-based and Co-based superalloys at elevated temperatures will be presented. Emphasis will be placed on the correlation between the third body formation process (e.g. oxide layer formation, transferfilms) and the tribological behavior of the superalloys. This talk will conclude with the future strategies of tribological coating solutions in gas turbine engines.

Author Index

Bold page numbers indicate presenter

— C —
Cordill, M.: SIT2-TuSIT-1, **2**

— M —
Muratore, C.: SIT1-MoSIT-1, **1**

— S —
Stoyanov, P.: SIT3-WeSIT-1, **3**