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.

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