Transition Metal Dichalcogenides (TMDCs): Synthesis, Characterization and Applications in tribo-logy-tronics

Kapil Bhorkar[&] [1,#], Panagiotis Kourelias[2], Dimitrios Poligenis[2] and **Spyros Yannopoulos**

1] Foundation for Research and Technology-Hellas, Institute of Chemical Engineering and High Temperature, Patras, Greece

2] Department of Physics, University of Patras

[&]Also at University of Rennes 1, Rennes, France

Presenting author: Kapil Bhorkar, email: kapilbhorkar@gmail.com
* Corresponding author: Spyros Yannopoulos, email: sny@iceht.forth.gr

ABSTRACT

Soon after the upsurge of graphene-related science and technology, tremendous interest has emerged for other, and potentially more useful, layered or 2-D materials. Transition Metal Dichalcogenides (TMDs) of the form MX_2 (M: Mo, W, Ta, etc.) and X: S, Se, Te, are nowadays extensively explored for applications in optoelectronics, catalysis, energy conversion etc., due to their layer dependent electronic and optical properties. However, long before the 2-D materials era begun, which led to the successful implementation of techniques to exfoliate single layers, graphite and MoS_2 were notably important materials known as solid lubricants, with viable applications in industry.

In the context of an ITN project, we have started a systematic approach in our lab attempting to devise simple scalable synthetic routes to grow TMDs and various combinations of them (heterostructures). Our approach is mainly based on chemical vapor deposition and physical vapor depositionaimed at controlling layer thickness down to the monolayer. Focus has been on the clarification of possible relations between their physico-chemical properties and friction at the nanoscale. TMDs and their combinations are grown on various substrates and precursor compounds to understand fundamental phenomena related to the effect of substrate on the lubricity, and the impact of the growth technique on the coefficient of friction. Other directions relate to the study of the degradation mechanism of widely used sputtered TMDs coatings under conditions of tribological performance. Apart from optimizing solid lubricants at the nanoscale, current plans also include investigations of the triboelectrification potential of such materials in the emerging field of tribotronics.

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 721642: SOLUTION.