Contribution ID: **83** Type: **Poster Communication**

Molybdenum disulfide coated gold nanostructures for biosensing using SERS

Wednesday 6 September 2023 19:15 (20 minutes)

Molybdenum disulfide (MoS_2) is a two-dimensional (2D) semiconductor that has attracted significant attention due to its properties, such as a band gap energy dependent on the layers'number and a large specific surface area prone to chemical functionalization. These properties make 2D MoS_2 an excellent platform for optical sensing applications [1,2]. For example, the combination of MoS_2 layers with plasmonic metals (e.g. Au) allows the fabrication of materials with potential to detect a variety of biomolecules by exploring the surface-enhanced Raman scattering (SERS) effect [3,4].

Herein, we report our research on MoS_2 nanosheets prepared by a hydrothermal method that subsequently have been deposited on different types of substrates. These nanocomposites were firstly assessed for their SERS performance by using the dye rhodamine B (RhB) as the analyte, under a range of operational conditions, which included the deposition method and the type of underlying substrate used in such deposition process. The most intense Raman signal due to chemisorbed RhB was observed for the Au substrates coated with the MoS_2 layers. Hence, these platforms have been investigated to detect lactate in buffer medium, as an important biomarker used for sports performance monitoring. Hence, the immobilization of lactate dehydrogenase (LDH) on neat gold substrates was firstly performed envisaging the indirect detection of lactate using SERS. The vibrational data obtained in these experiments have been interpreted considering the specific recognition of lactate by the biofunctionalized substrates. Finally, we discuss preliminary research on the MoS_2 coated Au nanostructures in the SERS detection of lactate via the enzyme immobilization method mentioned above (see scheme in appendix).

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Acknowledgements
This work was developed within the scope of the project CICECO –Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC) and when appropriate cofinanced by FEDER under the PT2020 Partnership Agreement. S. F. thanks FCT for her research contract (REF-069-88-ARH-2018), which is funded by national funds (OE), through FCT-Fundação para a Ciência e Tecnologia, I.P.

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Session Classification: Poster Session