Transition metal dichalcogenides (TMDs) materials for gas sensing application

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Inspired by the successful application of graphene based chemical gas sensors, 2D layered transition metal dichalcogenides (TMDs) materials have recently received immense attention and become the principal objective of many researches and gas sensing studies. They are consisted of a metal atomic layer sandwiched between two atomic layers of a chalcogen material where the layers are stacked one above the other by Van der Waals forces of interaction (Fig. 1). Owing to their direct band gap, nanoscale thickness and large specific surface area (sheet-like structures), the "4S" sensor performances, i.e., sensitivity, selectivity, stability and speed (response-recovery time) are highly improved. [1,2] Indeed, the thinning of the bulk material to a single or few layers leads to a drastic change of its inherent properties, primarily due to the confinement of charge carriers in two dimensions (x- and y-directions) due to the low or absence of interactions in the z-direction. Among the 2D TMDs materials that have demonstrated their feasibility for gas sensing application, we found WS2, MoS2 and SnS2. They have shown promising results towards various gases and VOCs, at very low operating temperatures. They are obtained by means of different routes including chemical or electrochemical Li-interaction and exfoliation, a mechanical cleavage method, liquid-phase exfoliation, chemical vapour deposition (CVD), and a wet-chemical method.

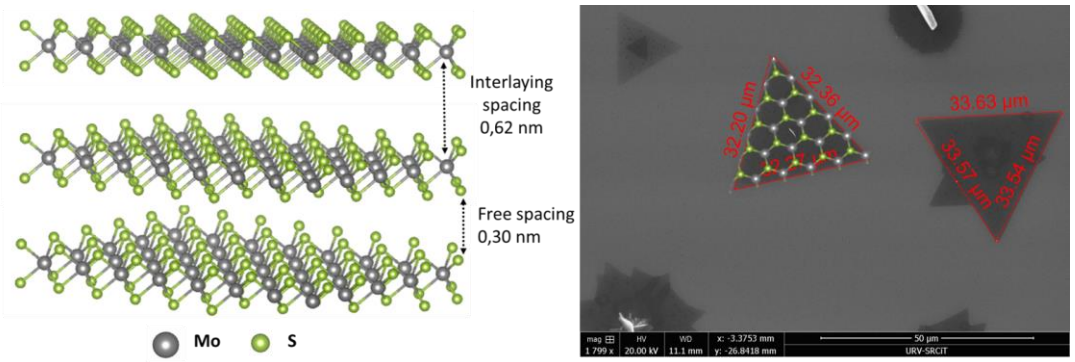

Fig. 1. Molybdenum disulphide (MoS_2) multilayers grown by using atmospheric pressure CVD.

[1] A. Alagh, F.E. Annanouch, P. Umek, C. Bittencourt, J.F. Colomer, E. Llobet, IEEE Sens. J. **21**, 21212 (2021).

[2] A. Alagh, F.E. Annanouch, P. Umek, C. Bittencourt, A. Sierra-Castillo, E. Haye, J.F. Colomer, E. Llobet, Sensors Actuators B Chem. **326**, 128813 (2021) 128813.