Two-dimensional oxide from surface of liquid chalcogen mixture

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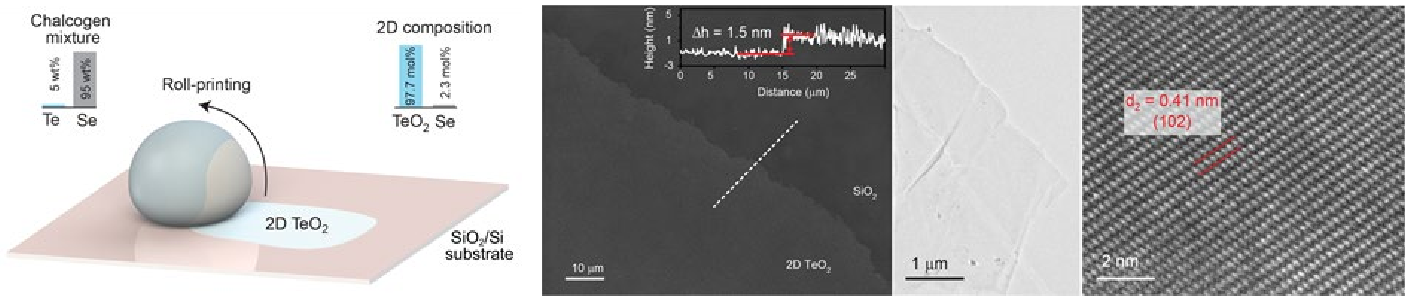
Two-dimensional (2D) materials have attracted significant interests from the research and industrial communities due to their unique physical and chemical properties. Although various synthesis approaches exist, some possess complex optimisation and require high operating temperature, which precludes synthesis of some materials. Liquid metals (LMs) and metal alloys offer an alternative 2D material synthesis platform as the Cabrera-Mott oxidation reaction occurs at the solid-gas interface once exposed to ambient conditions [1]. As a result, a smooth and ultrathin oxide layer attaching weakly to the LM solvent forms, which can then be transferred onto desired substrates. To date, several LM-based syntheses have been developed and gained popularity since they offer scalable, low-temperature, cost-effective, and vacuum-free alternatives to the conventional processes. Furthermore, naturally non-stratified materials can be obtained thanks to these techniques. In this work [2], we presented a roll-printing method performed on liquid eutectic chalcogen mixture (selenium-tellurium) to synthesise a novel 2D tellurium oxide (β-TeO_2). Theoretically, this material owns promising properties for electronic applications and has never been experimentally explored. The isolated 2D oxide was subsequently integrated into a basic electronic device and exhibited remarkable performances paving a way to a development of advanced applications.



[1] Cabrera, N., Mott, N. F., Theory of the oxidation of metals. *Rep. Prog. Phys.* **1949,** *12* (1), 163-184.

[2] Zavabeti, A., Aukarasereenont, P., Tuohey, H., Syed, N., Jannat, A., Elbourne, A., Messalea, K. A., Zhang, B. Y., Murdoch, B. J., Partridge, J. G., Wurdack, M., Creedon, D. L., van Embden, J., Kalantar-Zadeh, K., Russo, S. P., McConville, C. F., Daeneke, T., High-mobility p-type semiconducting two-dimensional β-TeO_2. *Nat. Electron.* **2021,** *4* (4), 277-283.