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New horizons for interfaces by oxide membranes

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The study of thin films has been a cornerstone of experimental research at reduced dimensions. Furthermore, the interest in 2d materials and heterostructures has grown rapidly in the last two decades since the discovery of graphene, and has really exploded after highly correlated electronic phases and superconductivity were found in twisted bilayer graphene. However, there exists a whole other class of materials, namely oxides, where precise control over stoichiometry, interfaces and thickness can be achieved at the nanoscale using a variety of growth techniques. These oxides exhibit nearly all flavours of physical phases from magnetic to ferroelectric to superconducting to even exotic multiferroic ground states. I will take this opportunity to focus on recent developments in oxide growth enabling the separation of the grown thin film from the growth substrate, resulting in free standing oxide membranes[1]. These membranes have allowed for unprecedented access to avenues in oxides, with novel symmetry disallowed interfaces, which go beyond the epitaxially possible atomically sharp interfaces. I will show striking phenomena we have observed with an exemplary $SrTiO_3$ (001) on a sapphire (0001) interface [2], through which I hope to convey how these developments in oxides promise a fertile ground for remarkable discoveries in physics and materials science.

References:

[1] D. Lu *et al.*, *Nat. Mater.* 15, 1255 (2016).

[2] Wang*, Harbola* *et al.*, *Adv. Mater.* 35, 2210989 (2024).