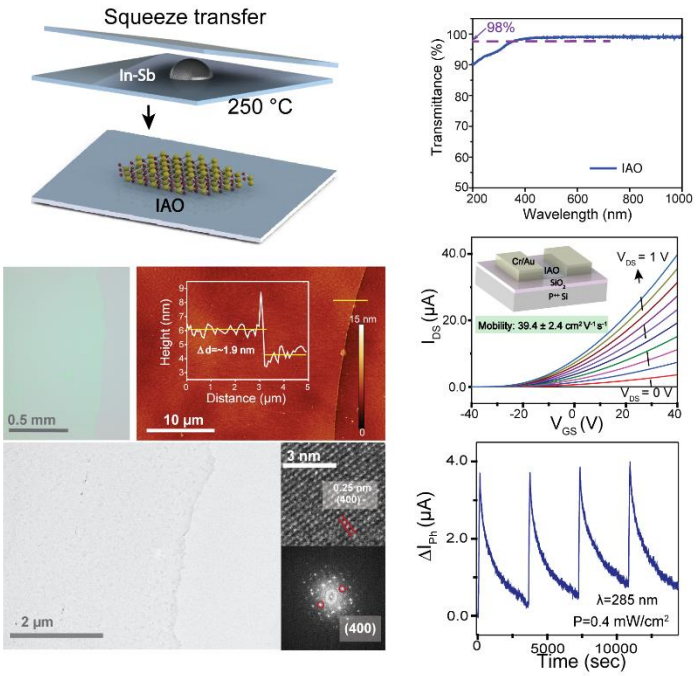
Atomically thin antimony-doped indium oxide nanosheets from liquid metal

Chung Kim Nguyen[a], Nitu Syed[ab], Torben Daeneke[a]

[a] *School of Engineering, RMIT University, Melbourne, VIC 3001, Australia.*

[b] *School of Physics, The University of Melbourne, Parkville, VIC 3010, Australia.*

Wide bandgap semiconducting oxides are emerging as potential 2D materials for transparent electronics and optoelectronics. This fuels the quest for discovering new 2D metal oxides with ultrahigh transparency and high mobility. While the former can be achieved by reducing the thickness of oxide films to only a few nanometers, the latter is more commonly realized by intentional doping. This work reports a one-step synthesis of few-unit-cell-thick and laterally large antimony-doped indium oxide (IAO) [1]. The doping process occurs spontaneously when the oxide is grown on the surface of a molten Sb–In alloy and 2D IAO nanosheets can be easily printed onto desired substrates. With thicknesses at the atomic scale, these materials exhibit excellent transparency exceeding 98% across the visible and near-infrared range. Field-effect transistors based on low-doped IAO nanosheets reveal a high electron mobility of ≈40 $cm^2 V^{-1} s^{-1}$. Additionally, a notable photoresponse is observed in 2D IAO-based photodetectors under ultraviolet (UV) radiation. Photoresponsivities of low-doped and highly doped IAO at a wavelength of 285 nm are found to be 1.2×10^3 and 0.7×10^3 A W^{-1}, respectively, identifying these materials as promising candidates for the fabrication of high-performance optoelectronics in the UV region.



[1] Nguyen, C. K., Low, M. X., Zavabeti, A., Murdoch, B. J., Guo, X., Aukarasereenont, P., Mazumder, A., Dubey, A., Jannat, A., Rahman, Md. A., Chiang, K., Truong, V. K., Bao, L., McConville, C. F., Walia, S., Daeneke, T., Syed, N., Atomically Thin Antimony-Doped Indium Oxide Nanosheets for Optoelectronics. *Adv. Optical Mater.* 2022, 2200925.