Maruda Shanmugasundaram[1]
Andrey Krayev,[1] Connor Bailey,[2] Kiyoung Jo,[3] Shuo Wang,[4] Akshay Singh,[5] Thomas Darlington,[6] Gang-Yu Liu,[4] Silvia Gradecak,[5] P. James Schuck,[6] Eric Pop,[2] Deep Jariwala[3]
1 HORIBA Scientific, 20 Knightsbridge Road, Piscataway NJ USA 08854
2 Department of Electrical Engineering, Stanford University, Stanford CA USA 94305
3 Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia PA USA 19104
4 Department of Chemistry, University of California, Davis CA USA 95616
5 Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge MA USA 02139
6 Department of Mechanical Engineering, Columbia University, New York NY USA 10027

maruda.shanmugasundaram@horiba.com

Dry Transfer of van der Waals Crystals for Nanoscale Characterization of Buried Interfaces

The synthesis and characterization of two dimensional (2D) transition metal dichalcogenides have attracted much attention in recent years due to their potential optoelectronic applications. However, due to the fact that they are synthesized mostly on insulating substrates, their characterization at a fundamental level has not been straightforward for as-grown crystals. Usually, they are transferred to noble metal substrates such as gold through exfoliation or polymer-assisted transfer, but these methods suffer from contamination of the crystal surface. Here, we present a simple method for clean, dry, and residue-free transfer of CVD-grown crystals to gold, which allows for easy and comprehensive nanoscale surface characterization using techniques such as Scanning Probe Microscopy (SPM) and Raman spectroscopy [1]. In particular, the combination of the two techniques enable tip-enhanced Raman scattering (TERS), leading to nanoscale Raman mapping at spatial resolutions better than 20 nm. Further, scanning Kelvin probe microscopy allowed for high resolution imaging of the surface potential, which provided key insights on the charge transfer between the crystals and the noble metal substrate. Thus, the transfer procedure demonstrated here is expected to enable robust optical and electronic characterization of a variety of different 2D materials. This is expected to be of particular importance in understanding metal contacts as well as buried interfaces in engineering devices based on 2D materials.

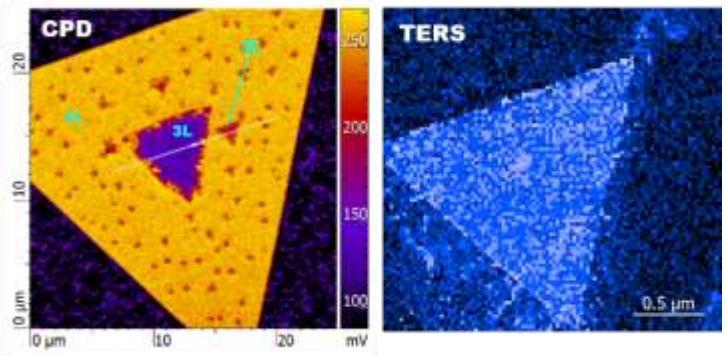

Figure 1: Scanning Kelvin Probe image (left) showing contact potential difference (CPD) and TERS image (right) of the 2-layer part (2L), measured from the buried layer of a CVD-grown WSe_2 crystal transferred to gold.[1]

References

[1] A. Krayev, C.S. Bailey, K. Jo, S. Wang, A. Singh, T. Darlington, G-Y. Liu, S. Gradecak, P.J. Schuck, E. Pop, D. Jariwala, ACS Appl. Mater. Interfaces, 41 (2019) 38218