Sefik Suzer et al., Madridge J Nanotechnol Nanosci. 2018
http://dx.doi.org/10.18689/2638-2075.a3.004

XPS Investigation of MoS_2 Transistor Structures Under Operating Conditions (Operando XPS)

Sefik Suzer[1]* and **Coskun Kocabas**[2]
[1]Department of Chemistry, Bilkent University, Turkey
[2]Department of Physics, Bilkent University, Turkey

MoS_2 is very promising channel material for next generation complementary metal-oxide-semiconductor (CMOS) applications, and others. However, very little is understood about functioning and/or the role of the ultra-thin MoS_2 films, in terms of chemical nature, morphology, defect structure, etc. In this presentation utilization of X-ray photoelectron spectrscopy (XPS), a popular chemical analysis tool, for investigation of electrical potential distribution across and within the device will be given. The device consists of two gold metal electrodes in the source-drain geometry, and has a ~200 μm MoS_2 channel in between, all fabricated on a SiO_2/Si dielectric substrate, which is gated through the Si substrate. Variations in the electrical potential distribution are detected by the shifts in the binding energies of the core levels of the corresponding atoms, in a completely non-invasive and chemically specific fashion. Accordingly, the difference in the position of the Au4f peak reflects the potential drop across the two electrodes, while the shifts in the Mo3d, S2p peaks are indicative of the potential variations along the width of the channel, and the shifts in the Si2p are induced by the gate voltage. As a result, it can easily be observed that all of these shifts are completely controlled by both the polarity and also the amplitude of the gate-voltage. This simple variant of XPS enables us to follow/detect/observe many of the electrical properties of the transistor-devices, in addition to giving rich chemical information about them. Methodology and findings will be presented and discussed.

Acknowledgment: This work is partially supported by the Scientific and Technological Research Council of Turkey (TUBITAK) Grant No. 215Z534