A combined microfluidic system for selective and real-time detection of TCNQ and F4-TCNQ on the channel of atomic layer MoS_2 field effect transistor

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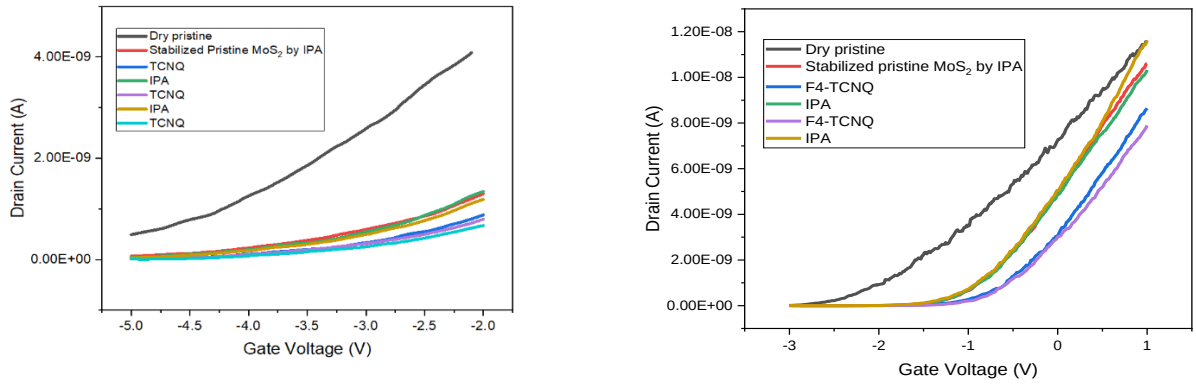
Abstract:

Molybdenum disulfide (MoS_2), one of the most fascinating transition metal dichalcogenides (TMDs) with tunable bandgap, is currently extensively investigated as an appropriate alternative of graphene due to its potentiality as an atomically thin channel material and viable prospects in the next decades for catalytical, electrical and optoelectronic applications[1,2]. In this study, tetracyanoquinodimethane (TCNQ) and 2,3,5,6-tetrafluoro-7,7,8,8-tetracyanoquinodimethane (F4-TCNQ) molecules were used to functionalize the MoS_2-FET microfluidic channel and by threshold voltage (ΔV_{th}) shifting on Id-Vg plots both molecules were shown to be electron acceptors. Furthermore, the back-and-forth behavior of Ids-Vg plots for the alternative addition of IPA solvent and molecular solution represent the switching sensor behavior of the of the fabricated MoS_2. The continuous real-time measurement of the MoS_2-FET was also performed during the alternative flow of molecular solutions (200µM) and pure IPA. It is seen that as soon as the molecular solution reaches the MoS_2 sensor signal starts to decrease indicating an electron transfer from the MoS_2 channel to the molecules.



(a) (b)

Figure 1: Id-Vg for the dry pristine to IPA stabilized pristine and switching behavior of drain current by alternative flow of (a) IPA and 200µM TCNQ (b) IPA and 200µM F4-TCNQ

References:

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2) Mak K F, Lee C, Hone J, Shan J and Heinz T F 2010 Phys. Rev. Lett. 105 136805