

Biodegradable albumen dielectrics for high-mobility MoS₂ phototransistors

Thomas Pucher

Pablo Bastante, Federico Parenti, Yong Xie, Elisabetta Dimaggio, Gianluca Fiori and Andres Castellanos-Gomez

Materials Science Institute (ICMM-CSIC), 28049, Madrid, Spain

thomas.pucher@csic.es

This work demonstrates the fabrication and characterization of single-layer MoS₂ field effect transistors using biodegradable albumen (chicken eggwhite) as gate dielectric. By introducing albumen as an insulator for MoS₂ transistors high carrier mobilities (up to ~90 cm²V⁻¹s⁻¹) are observed, which is remarkably superior to that obtained with commonly used SiO₂ dielectric which we attribute to ionic-gating due to the formation of an electric double layer in the albumen MoS₂ interface. [1,2] Additionally, the investigated devices are characterized upon illumination, observing responsivities of 4.5 A/W (operated in photogating regime) and rise times as low as 52 ms (operated in photoconductivity regime). The presented study reveals for the first time the combination of albumen with van der Waals materials for prospective biodegradable and biocompatible optoelectronic device applications. [3] Furthermore, the demonstrated universal fabrication process can be easily adopted to fabricate albumen-based devices with any other van der Waals material. [4]

References

- [1] Ma, Mingchao, et al. RSC Advances 4.102 (2014): 58720-58723
- [2] Perera, M. M., et al. ACS Nano (2013): 4449-4458
- [3] Chen, Ying-Chih, et al., Scientific reports 5.1 (2015): 1-12
- [4] Castellanos-Gomez, Andres, et al., 2D Materials 1.1 (2014): 011002

Figures

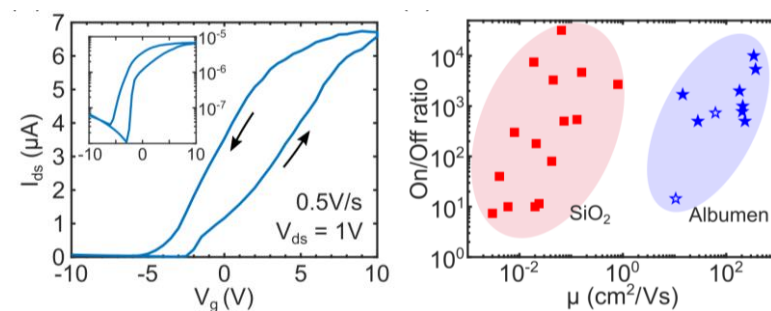


Figure 1: Transfer curve for one device and On/Off ratio vs mobility for all albumen devices compared to SiO₂-based devices

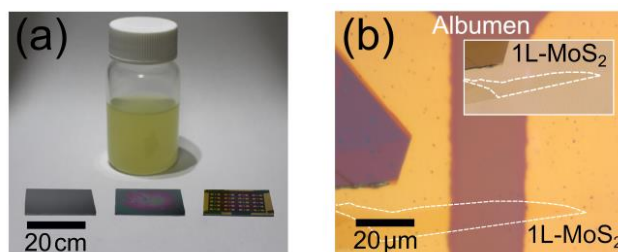


Figure 2: (a) Fabrication steps; (b) Microscope image of fabricated 1L-MoS₂ albumen transistor