# Electrical and optical properties of LSMO/Monolayer $MoS_2$ photodiodes

Yue Niu[1,2*], Riccardo Frisenda[1], Simon A. Svatek[1], Gloria Orfila[3,4],Weicheng Jiao[2], Rongguo Wang[2], Nicolás Agraït[1,5], Federico Monpean[6], Carlos León[3,4], Alberto Rivera-Calzada[3,4], David Perez De Lara[1], Jacobo Santamaria[3,4], Andres Castellanos-Gomez[*]

1 Instituto Madrileño de Estudios Avanzados en Nanociencia (IMDEA-Nanociencia), Faraday 9, Ciudad Universitaria de Cantoblanco, 28049, Madrid, Spain

2 National Key Laboratory of Science and Technology on Advanced Composites in Special Environments, Harbin Institute of Technology, Harbin, China

3 GFMC, Departamento de Fisica de Materiales. Universidad Complutense de Madrid, 28040 Madrid, Spain.

4 GFMC, Instituto de Magnetismo Aplicado "Salvador Velayos", Universidad Complutense de Madrid, 28040 Madrid, Spain.

5 Departamento de Física de la Materia Condensada. Universidad Autónoma de Madrid, Madrid, E-28049, Spain.

6 Instituto de Ciencia de los Materiales de Madrid (ICMM-CSIC), Madrid, E-28049, Spain.

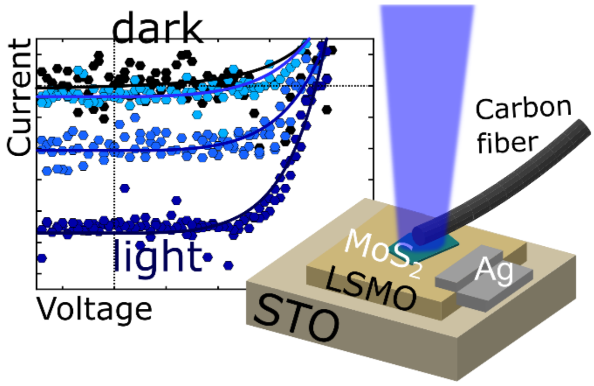
## Keywords:

Molybdenum disulfide, Lanthanum strontium manganite oxide, van der waals heterostructures, optoelectronics, PN junction, 2D materials.

Two dimensional (2D) transition metal dichalcogenides (TMDs) and artificial van der Waals heterostructures made from these materials have been experimentally and theoretically investigated as promising candidates for novel photovoltaic and optoelectronic devices due to their excellent optical and electrical properties[1,2]. Very recently, many experimental efforts have been made on the fabrication and study of 2D-2D heterostructures,like for example $MoS_2$-$WS_2$ and graphene-$MoS_2$[3,4] and 2D-3D heterostructures, such as graphene-Si. Nevertheless, the interaction between two dimensional material and transition metal complex oxides has not been largely investigated so far. In this work, we investigate heterostructures made of 3D lanthanum strontium manganite oxide (LSMO) and 2D monolayer $MoS_2$ and report their photodiode behavior.

Here, we report the photodiode behavior in LSMO (p type)/monolayer $MoS_2$ (n type) heterostructures fabricated by deterministic transfer of mechanically exfoliated flake and transfered to LSMO[5]. Under illumination, an obvious photocurrent (and photovoltage) is generated by the photovoltaic effect. The photocurrent and photoresponsivity are dependent both on the incident light wavelength and power density. The device displays short-circuit currents up to 0.4 nA and open-circuit voltages up to 400 mV. Measuring as a function of incident optical power density, we find that the open-circuit voltage and short-circuit current depend linearly and logarithmically, respectively, on power density, confirming an ideal photodiode behavior.

In conclusion, we have investigated the electrical and optoelectronic properties of LSMO/monolayer $MoS_2$ heterostructures. Our work may benefit to the integration of two-dimensional materials with metal complex oxides. This might contribute to developments in the area of van der Waals heterostructures and it will provide novel applications in electronics and optoelectronics.

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