

29th International Conference on **Nanomaterials and Nanotechnology**
&
4th Edition of International conference on
Advanced Spectroscopy, Crystallography and Applications in Modern Chemistry
April 25-26, 2019 Rome, Italy

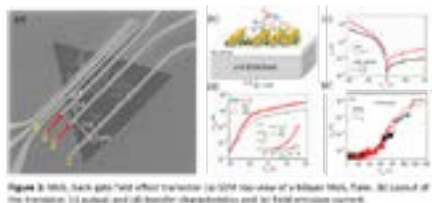


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2D transition metal dichalcogenides in electronic devices

Transition-metal dichalcogenides, such as MoS₂, WSe₂, or PdSe₂, have recently become very popular for next-generation electronic devices and sensors as an alternative or a complement to graphene. Such materials offer remarkable properties, which include layer-dependent bandgap, intrinsic n- or p-type conduction, good mechanical strength and chemical stability, strong light interaction and high sensitivity to several environmental parameters. Monolayer WSe₂ and MoS₂ have 1.6-1.8 eV direct bandgap and enable field-effect transistor with high On/Off current ratio and strong photoresponse. Few-layer PdSe₂ has an 1.3 eV indirect bandgap, largely dependent on the number of layers, and exhibits ambipolar conduction with easily tuned n- and p-type balance. A challenge in the use of these materials is the achievement of high carrier mobility, which typically results in the order of few tens cm²V⁻¹s⁻¹, and the sensitivity to oxygen, water or other adsorbates and process residues, which strongly affect their performance. Here, we discuss the current-voltage characteristics at high drain bias of monolayer MoS₂ transistors with Schottky contacts. We show that oxidized Ti contacts, due to a long air exposure, form rectifying junctions on MoS₂ and cause asymmetric output characteristics, which we explain in terms of two back-to-back Schottky barriers with slightly unbalanced barrier heights. We use MoS₂ transistors with ohmic contacts, at lower drain bias, to investigate the photoconductive and photogating effects. We point out that the photoconductivity can persist with a decay time longer than 104 s, due to photo-charge trapping in extrinsic and intrinsic defects. By focusing on the hysteretic behavior of the transistor transfer characteristics, we demonstrate that positive charge trapping is dominant in 2D-materials on SiO₂ dielectric and can be used to realize memory devices. We investigate the effect of irradiation by low-energy electrons during the usual SEM imaging and show that its detrimental effect is partially recovered after a long time annealing at room temperature. Finally, taking advantage from the n-type conduction, combined with the low work function, the sharp edge geometry and the elasticity of the material, we demonstrate field emission current from few-layer MoS₂ and WSe₂, which is promising for vacuum electronic applications [2,6-7]. In particular, we prove that the field emission current from a WSe₂ flake can be modulated by a back gate and propose a new field emission transistor.



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Biography

Antonio Di Bartolomeo is an Associate Professor of Experimental Condensed Matter Physics at the Salerno University, Italy. He has spent several years in industry as System Engineer (Creative Electronic Systems, CH) and Device Engineer (ST Microelectronics, AZ, and Intel Corporation, IE). He has been visiting scientist at IHP Microelectronics, Frankfurt Oder, Germany, and at Georgetown University, Washington, DC. He has co-authored more than 100 peer-reviewed research articles and two textbooks on general Physics. He has been serving as editorial board member of several journals such as Nanotechnology, Journal of Physics D and Nano Future by IOP, Nanomaterials and Sensors by MDPI, and Micro & Nano Letters by IET. His present research interests include: Optical and electrical properties of carbon nanotubes, graphene and 2D materials; van der Waals heterojunctions of 2D layered materials and their application as photodetectors, solar cells and chemical sensors; field-effect transistors, Schottky heterojunctions, non-volatile memories and field emission devices.

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