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# Hysteresis-Free Multilayer $MoS_2$ Transistor Using $O_2$ Plasma and $Al_2O_3$ Passivation

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The recent technology for high performance electronic devices have triggered the investigation on next-generation high mobility semiconductors, especially for applications in OLED displays and wearable electronics. Amorphous silicon (a-Si:H) is commonly used thin-film transistor in active matrix liquid crystal displays, however a relatively low mobility of a-Si:H TFTs (approximately 1 $cm^2 V^{-1} s^{-1}$) has its limit in a high resolution of flat panel displays. In that regard, LTPS devices that exhibit practical mobility values exceeding 50 $cm^2 V^{-1} s^{-1}$ have been considered as alternatives, but the highly manufacturing costs prevent them from becoming common and scale-up. The class of high mobility semiconductors have a lot of attention in two-dimensional (2D) transition metal dichalcogenides (TMDs), which are considered as potential substitutes for the conventional thin-film transistor, because it exhibited a high mobility near 200 $cm^2 V^{-1} s^{-1}$. Therefore, 2D TMDs will open up new market in this field that require thin film devices with high electrical performance, such as high resolution displays that require extremely low power consumption. Despite the excellent electrical properties, hysteresis effects for a transistor are observed in transfer characteristics. Such phenomena attributes to the infiltration of moisture ($H_2O$) and oxygen ($O_2$) molecules that act as positive charges, which either trap or release electrons during the forward and reverse gate voltage sweeps. In this study, we present a method to hysteresis-free multilayer $MoS_2$ field-effect transistors (FETs) through $O_2$ plasma treatment and $Al_2O_3$ passivation. The $MoS_2$ FETs were exposed to $O_2$ plasma for 30 s prior to $Al_2O_3$ encapsulation showing a relatively small hysteresis and high electrical performance. The $MoO_x$ layer formed during plasma treatment exists between $MoS_2$ and the top passivation layer, where $MoO_x$ interlayer prevents the generation of excess electron carriers in the channel due to $Al_2O_3$ passivation, which minimizes the shift of threshold voltage ($V_{th}$) and the increase of off-current leakage. However, the long-time plasma treatment (90 and 120 s) introduces excess oxygen into the $MoO_x$ leading to persisted hysteresis and high off-current. This simple approach can be applied to other TMD materials and the obtained high performance and hysteresis-free $MoS_2$ transistors open up new opportunities for future electronics.[1]

[1]Na Liu, et al, ACS Applied Materials & Interfaces 9(49), 42943-42950 (2017)

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## The Convergence of Technologies Generates Convergence in the Regulations

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The convergence of nanotechnologies generates synergies among different technologies to say, nanotechnologies, neurotechnology, computers and biotechnology, these technologies must converge (7) their regulations, the application of medical devices in nanotechnologies should lead us to a link between the technical committee TC 210 and ISO technical committee 229 links that does not exist in our work in this moment. In this we do an analysis of the management of risk from an optical NC-ISO 14971 (1). Studying the global trend in this respect as imported for manufacturers medical devices worldwide. The convergences of technologies are a consequence of an atomic precision, where the boundary between the biotic and abiotic mute blur the interaction. The interaction between nanotechnologies, biotechnology and informatics and communications (NBI) generates a synergy of unusual consequences of all is known that the industry of semiconductor (5)s is the one of greatest precision that is atomic, the new medical devices that will be applied in the teranocis will dose physical principles that will be governed under the laws of quantum mechanics (4), but there are two problems that have not been solved even though they are one the non-existence of quantum biology and the transition from quantum to classical mechanics. On the other hand, the redefinition of the international system of units based on the universal constants that will be implemented by 2018 has a deficiency that is the second that redefirms implies redefinition of the meter the chain of traceability proposed for nanometrology presents a serious difficulty when putting the microcopy of atomic force wing of effect tunnel situation that is changing the verification of the Wiedemann-Franz law (8) at atomic level yields a result where the phononic component is taken into account, a result that launches STM to the cusp of the chain of traceability above inclusive of interferometry.

### Biography:

Guillermo Valdes Mesa born in Havana, Cuba in 1962, graduated in Physics in 1985, working for the Microelectronics Industry, as head of final control investigations degradation production of electronic components, working for the Electronics Industry, department of reliability, characterization work performed Luma-Chroma plate worker Research Institute of Metrology, work Challenges of Metrology in Cuba in the era of nanotechnology. Work published in the ISO TC 229, ISO TC229/IEC 113, required for conformity assessment of research and nano-scale productions Tool page, Master of Science.