Combining Freestanding Ferroelectric Perovskite Oxides with Two-Dimensional Semiconductors for High Performance Transistors

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Field Effect Transistors (FETs) based on silicon technology are facing limits during the last years. To overcome this obstacle an approach to miniaturize even more the devices can be developed, besides the performance can be improved to lower the power consumption, and thus the heat dissipation. But another approach can be used, which consists of adding new degrees of freedom, such as the polarization in a ferroelectric material, hence the device functionality is increased.

The remarkable properties of 2D materials together with their reduced vertical dimensions, directly positioned them as potential components in FET fabrication [1]. The extensive work, particularly on transition metal dichalcogenides-based FETs have proven their suitability, even surpassing the typical characteristics of the silicon-based transistors [2]. Moreover, the recent development of strategies to isolate complex oxide layers and manipulate them similarly to their van der Waals counterparts has placed new tokens on the board [3,4].

In this work [5], we integrate freestanding single-crystalline $BaTiO_3$ with monolayer MoS_2 flakes, showing mobilities larger than the ones obtained with standard SiO_2 and in the same order of magnitude of devices built with hexagonal boron nitride, which has already shown outstanding electrical properties in FETs [6]. Besides, the devices made with BaTiO3 show a wide hysteresis related to ferroelectric polarization switching in their electrical transfer curves, an appealing property in memory storage devices.

References

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Figures

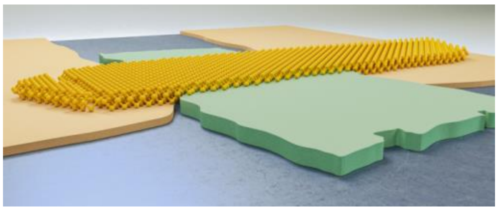

Figure 1: Artistic representation of a ferroelectric FET composed by a BTO layer (green shape) with a MoS2 (represented by a layer of yellow atoms) on top, connecting the two Au electrodes.