p-type-doped WSe_2 nanoelectronic devices fabricated by oxidation scanning probe lithography

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Oxidation Scanning Probe Lithography (o-SPL) is a direct, robust nanolithographic technique with sub-10 nm resolution and in-situ, non-destructive inspection after nanopatterning. The fabrication of working nano-devices on a wide variety of materials has been demonstrated [1]. In this work [2], we report the fabrication of 10 oxide nanowires with 36 nm half-pitch and the electrical characterization of a few-layer, p-type doped WSe_2 field-effect transistor, which channel consists in an array of 5 parallel nanoribbons with a half-pitch of 350 nm. The p-doping effect and the ability to control the width and the depth of the oxide nanoribbons come from an oxygen plasma treatment, prior to the o-SPL step, which forms a self-limited and uniform oxide layer on top of the WSe_2 flake. These results show the potential to optimize o-SPL to fabricate in a local and non-invasive way high-resolution 2D materials-based devices.

References

[1] Y. K. Ryu and R. Garcia, Advanced oxidation scanning probe lithography, **Nanotechnology** (2017), **28**, 142003.
[2] A. I. Dago, Y. K. Ryu, F. J. Palomares and R. Garcia, Direct patterning of p-type-doped few-layer WSe_2 nanoelectronic devices by oxidation scanning probe lithography, **ACS Applied Materials and Interfaces** (2018), **10**, 40054.

Figures

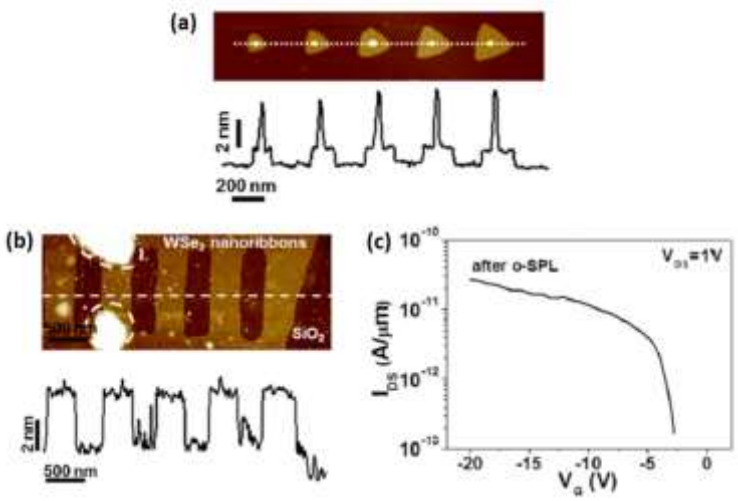

Figure 1. (a) o-SPL oxides fabricated on a pristine WSe_2 flake at arelative humidity of 42%, an applied voltage of 16.2 V and variable oxidation times in the range of 0.6 – 1.8 ms. (b) AFM topographic image of 350 nm half-pitch nanoribbons after o-SPL and water etching. (c) Transfer curve of the device shown in (b).