Selective and Conformal Deposition of Layered 2D $PtSe_2$

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2D $PtSe_2$ is continuing to attract considerable research interest due to its semi-metallic to semi-conducting transition at reduced thicknesses [1,2]. Here, we present method for conformal and selective deposition of $PtSe_2$ at back end of line compatible temperatures, enabling new fabrication routes through controlled patterned synthesis [3].
Platinum deposited by area selective atomic layer deposition is converted to $PtSe_2$ via thermal assisted conversion (Figure 1) [4]. The growth is described for a variety substrates and morphologies, including conformally on 3D topography, and is characterized by Raman, spatially resolved X-ray photoelectron spectroscopy, scanning and tunnelling electron microscopy. Furthermore, the fabrication of a 3D highly sensitive ammonia sensor and a fully integrated infrared-photodetector on silicon photonic waveguides demonstrate the versatility of this approach.

References

[1] L. Zeng et. al, NPG Asia Mater 10 (2018) 352–362.
[2] L. Ansari et. al., npj 2D Mater Appl 3 (2019) 1–8.
[3] M. Prechtl et. al, Adv Funct Materials 31 (2021) 2103936.
[4] C. Yim et. al, ACS nano 10 (2016) 9550–9558.

Figures

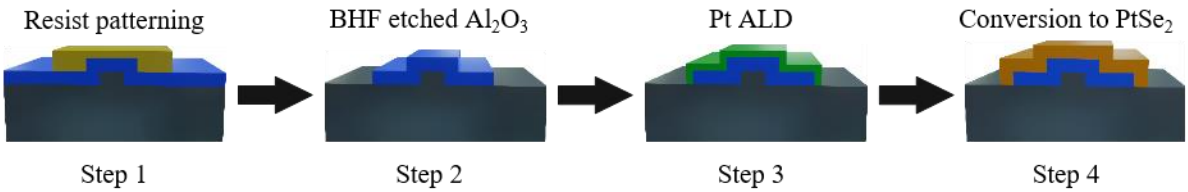

Figure 1: Process flow for selective and conformal deposition of $PtSe_2$. Al_2O_3 deposited by atomic layer deposition on silicon photonic waveguide structures is patterned using electron beam lithgraphy (Step 1). After buffered hydrofluoric acid (BHF) etching using the resist as hard mask (Step 2) Pt is selectively and conformally deposited (Step 3) and finally converted to $PtSe_2$ (Step 4).

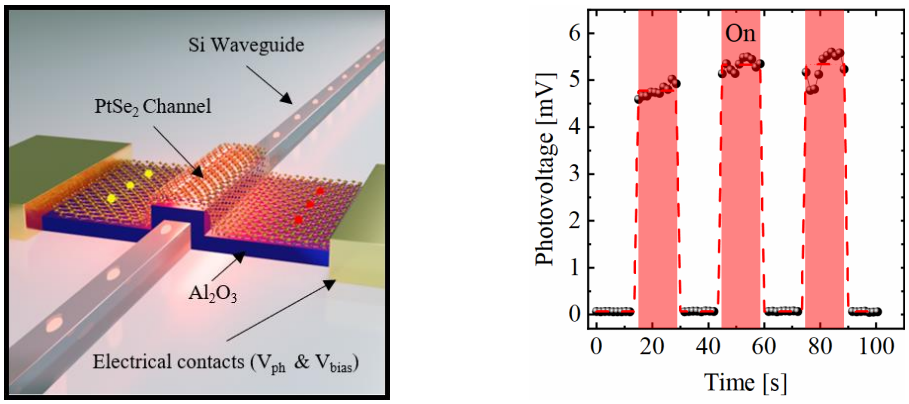

Figure 2: Left: Schematic of a fully integrated IR-photodetector using selectively and conformally deposited $PtSe_2$ as the active sensing material. Right: Time resolved photoresponse under pulsed excitation.