NanoFrazor Technology: Enabling Unique 2D Material Device Fabrication

N. Hendricks
M. Käppeli, J. Vergés, J. Chaaban, and E. Çağin
Process and Applications Lab., Heidelberg Instruments Nano, Bändliweg 30, 8048 Zürich, Switzerland
nicholas.hendricks@himt.ch

2D materials are enabling exciting new electrical and optical devices. To realize the true potential of such novel materials, nanofabrication techniques and processes must advance equally. One nanofabrication technique that is gaining interest in the 2D material community, both academically and industrially, is that of thermal scanning probe lithography (t-SPL) facilitated by the NanoFrazor technology [1]. As a direct-write nanolithography technique, t-SPL generates patterns by scanning a cantilever with an ultrasharp tip (radius <10nm) over a sample surface to induce local changes with a thermal stimulus (via an integrated heating element), all without the need for energetic particles. Integrated within the cantilever is a thermal topography sensor that allows for real time surface topography measurements that enables closed-loop grayscale patterning (with 1nm vertical accuracy [2]) and marker-less overlay to generate patterns on 2D materials (with <5nm precision [3]) without the aid of alignment markers.

Within this presentation, the background and workings of t-SPL will be briefly introduced and nanostructuring on 2D materials will be discussed along with electrical and optical device performance for 2D material-based devices fabricated with t-SPL.

References

[1] Howell et al., Microsystems & Nanoengineering, 6 (2020) 21
[2] Kulmala et al., Proc. SPIE 10584, Novel Patterning Technologies 2018, 1058412 (2018)
[3] Rawlings et al., IEEE Transactions on Nanotechnology, 6 (2014) 1204
[4] Zheng et al., Nature Electronics, 2 (2019) 17

Figures

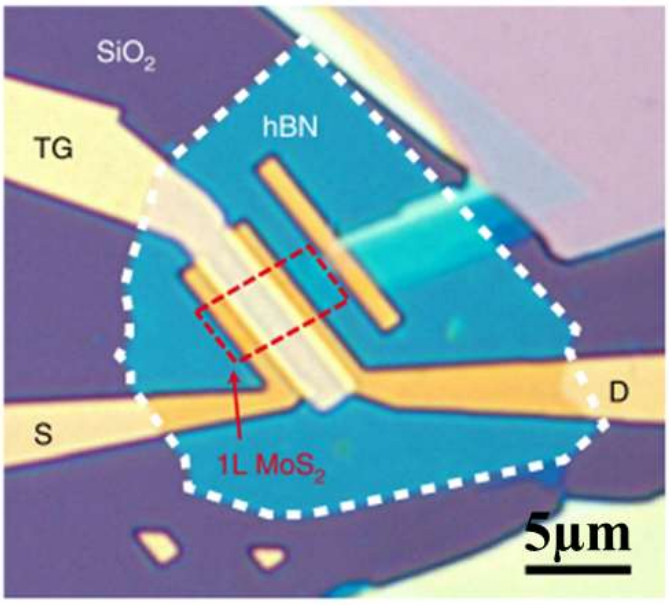

Figure 1: Optical microscope image of single layer molybdenum disulfide (MoS_2) with h-BN dielectric. Source (S), drain (D), and top-gate (TG) electrodes were patterned with t-SPL. [4]