

Thermal Scanning Probe Lithography for the Damage-Free Fabrication of 1D and 2D Devices

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The NanoFrazor utilizes thermal scanning probe lithography (t-SPL) to simultaneously write and read nanoscale structures, while also integrating direct laser sublimation (DLS) for hybrid lithography of nanodevices [1]. Unlike standard lithography methods such as e-beam, t-SPL does not involve a charged beam, preventing damage and enabling higher quality electronic devices and superior contacts on 1D and 2D materials [2,3]. Its in-situ reading capabilities also allow for markerless lithography: designs are directly overlaid onto buried features. An automated overlay function can further increase throughput and user friendliness, and the Decapede multi-tip system enables parallel t-SPL patterning to enhance scalability and reproducibility with shorter processing time. In this talk, I will present how the NanoFrazor facilitates the fabrication of various nanoelectronics devices, using a mix&match combination of t-SPL and laser lithography to contact multi-layer flakes and nanowires.

References

- [1] S. T. Howell et al., *Microsystems & nanoengineering*, 6 (2020) 21
- [2] Shani, Lior, et al., *Nanotechnology*, 35 (2024) 255302
- [3] Zheng, Xiaorui, et al., *Nature Electronics*, 2 (2019) 17-25

Figures

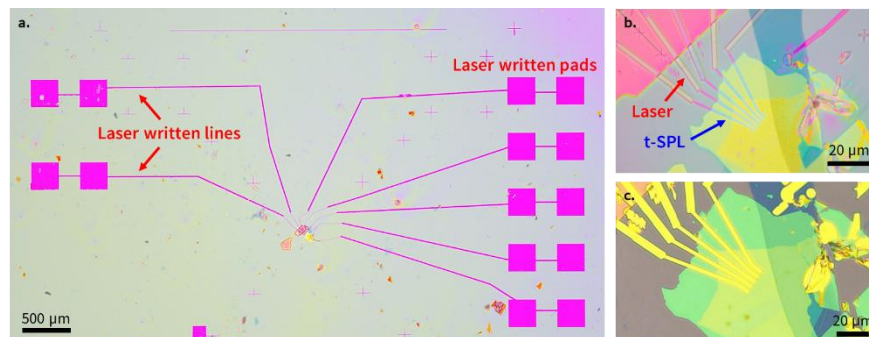


Figure 1: Contacting multi-layer flakes of hBN/graphene/hBN using t-SPL and laser mix & match lithography. a) Full image of the device after patterning into the imaging resist and wet etch development. b) Close-up of the multi-layer flakes including high-resolution t-SPL contacts. c) After metallization, all contacts are functional.

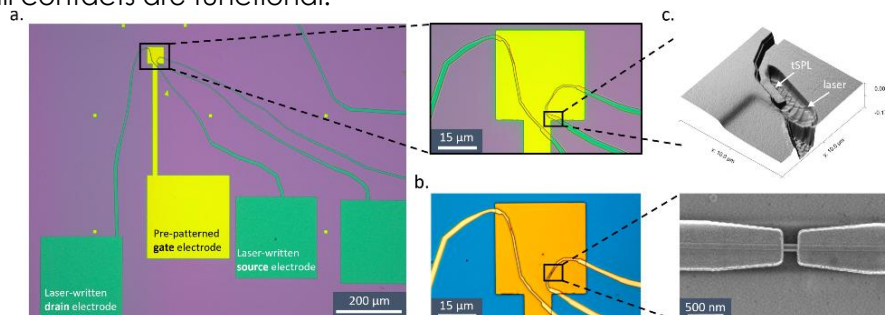


Figure 2: (a) Full image of the nanowire quantum device after patterning into the imaging resist, the large vias and the pads were written using laser, the high-resolution electrodes were patterned using t-SPL. (b) Optical image of the devices after metal deposition, a zoom-in SEM image of contacts on a InSb nanowire is shown. (c) Topography scan of the overlap between the t-SPL and laser-written areas of the electrode lines, showing a continuous line across both sections of the electrode. [2]