Naturally Formed Contacts: Growth of Advanced 2D Materials-Based devices

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Abstract

Statement of the Problem: Next generation smart solar cells and energy storage devices are envisioned to be lightweight, flexible and high performance, requiring new materials and device architectures. Though silicon forms the backbone of modern technology from cell phones to solar cells, significant limitations in speed, efficiency, flexibility, sustainability, and scalability are being realized. Two-dimensional (2D) materials, with exceptional electronic and optical properties present an opportunity to enhance the capabilities of traditional silicon-based technologies. However, the challenge of processing 2D material into working devices reproducibly, and scalability, is the largest impediment on their technological potential.

Methodology & Theoretical Orientation: we developed a new process for creating as-grown, naturally contacted, 2D material-based devices, which are scalable, reproducible, and potentially CMOS compatible with broad implications for basic research and industrial applications. We begin with lithographically defined metallic patterns around which 2D material is grown, forming self-contacted as-grown device structures in a single step.

Findings: Preliminary results have demonstrated the feasibility of this process through the direct growth of photosensitive devices.

Conclusion & Significance: Since the material grows controllably around the lithographically defined patterns, wafer scale circuits and complex device geometries can be produced including lateral heterostructures of different TMD materials.

Image

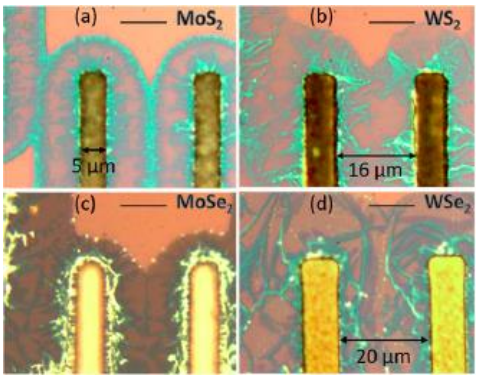


Figure 1Optical images for the four TMD growths. (a) MoS2 grown on Mo contacts. (b) WS2 grown on W contacts, (c) MoSe2 grown on Mo contacts, and (c) WSe2 grown on W contacts.

Recent Publications

1. Broadband femtosecond transient absorption spectroscopy for a CVD MoS_2 monolayer, Phys. Rev. B 94, 035445 (2016). By Shrouq H. Aleithan, M. Y. Livshits, S. Khadka, J. J. Rack, M. E. Kordesch, and E. Stinaff.
2. Concurrent Growth and Formation of Electrically Contacted Monolayer Transition Metal Dichalcogenides on Bulk Metallic Patterns, Adv. Mater. Interfaces 4, 1600599 (2017). By S. Khadka, M. Lindquist, Shrouq H. Aleithan, A. N. Blumer, T. E. Wickramasinghe, M. E. Kordesch, and E. Stinaff.
3. As-grown two-dimensional MoS_2 based photodetectors with naturally formed contacts, Appl. Phys. Lett. 110, 261109 (2017). By S. Khadka, T. E. Wickramasinghe, M. Lindquist, R. Thorat, Shrouq H. Aleithan, M. E. Kordesch, and E. Stinaff.
4. Growth of Complex 2D Material Based Structures with Naturally Formed Contacts, ACS Omega 4(5), 9557-9562, (2019). By Shrouq H. Aleithan, T. E. Wickramasinghe, M. Lindquist, S. Khadka and E. Stinaff



Biography

Shrouq Hassan Aleithan is an assistant Professor in King Faisal University, Saudi Arabia. She has her Ph.D. in condensed matter physics from department of Physics and Astronomy, Nanoscale and Quantum Phenomena Institute, Ohio University, Athens, Ohio, USA. She has knowledge, experience, in teaching and scientific research in physics. She servs the community in different fields and activities.

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