Enabling direct write fabrication of low dimensional micro- and nanostructures on supported and suspended substrates

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Low-dimensional nanomaterials, such as one-dimensional (1D) or two-dimensional (2D) systems, assembled in vertical or lateral arrangements, often lead to enhanced properties and new functionalities. Nanotubes, nanowires (NWs), and 2D layered structures (graphene and graphene like materials) are emerging as key building blocks for the next generation devices and emerging technologies. Practical implementation of such nanomaterials necessitates their successful incorporation with well-established processes for fabricating electronic and/or mechanical devices. While preparing layered architectures usually involves multi-step fabrication processes but relies on mask-assisted fabrication techniques. Here, we present a methodology for the controlled and selective preparation of nanostructures such as 1D NWs on 2D materials-substrates in various controlled geometric assemblies by employing direct write patterning (DWP) of custom ink precursors on supported or suspended architectures for subsequent chemical vapor deposition (CVD) synthesis. Our two-step fabrication approach enables simple and flexible routes to produce various architectures in a precisely controlled fashion. Location-specific materials synthesis provides access to as-grown interfaces and rapid testing of materials' quality, crystallinity, chemical composition, etc.

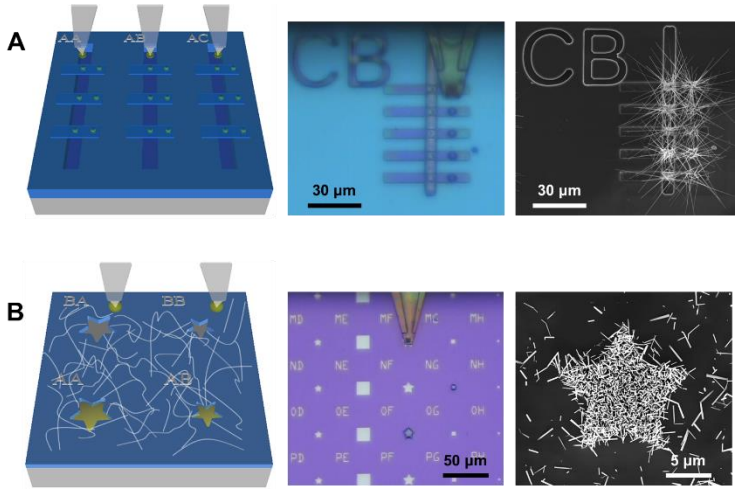

Figure1. Direct-write fabrication and synthesis of the nanostructures (**A)** Selective growth of ZnO NWs assemblies on suspended architectures via DWP approach and CVD synthesis. **(B)** 1D-2D interface formation using DWP and CVD synthesis.

[1] McCormack, K. et al. *Mater. Today Nano* **20**, 100241 (2022).
[2] Schaper, N. et al. *Nanomaterials* **11**, 1836 (2021).

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