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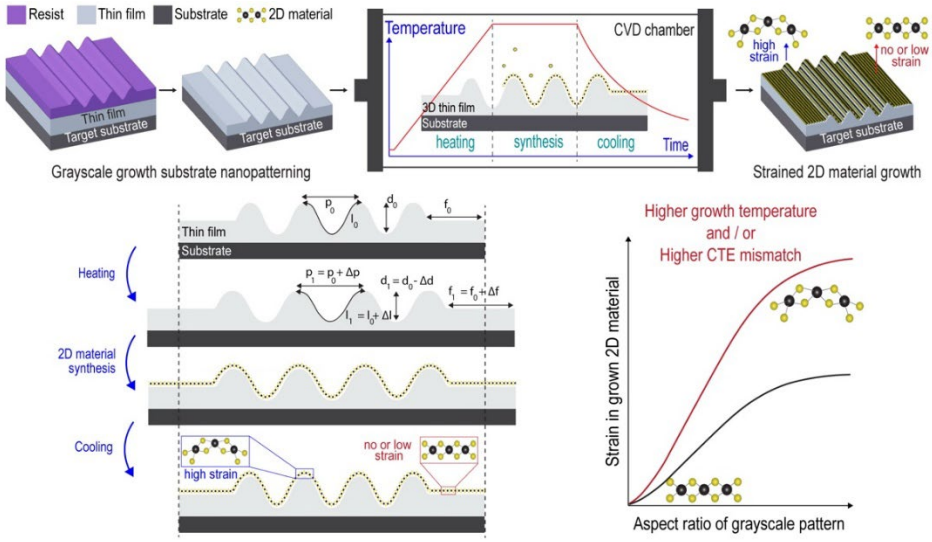
Licensing Opportunity

TTO – Technology Transfer Office

Strain-Engineered Growth of 2D Materials



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Keywords

2D materials, strain engineering, bandgap engineering, grayscale nanopatterning, thin films, nanoelectronics, transistor mobility

Intellectual Property

WO2026057317A1

Publication

Erbas B. et al., "Engineered Strain in 2D Materials by Direct Growth on Deterministically Patterned Grayscale Topographies," PubMed 41665438 (2026)

Description

The integration of two-dimensional semiconductors into commercial nanoelectronics is hindered by fundamental fabrication limitations: bottom-up growth methods lack reproducibility for complex device structures and their electrical properties are often insufficient for high-performance nanoelectronics, while transfer from growth substrates to target surfaces induces structural damage and residue contamination in atomically thin materials. Strain engineering, widely used as a mobility enhancer in silicon transistors, is also a proven technique to improve the electrical properties of two-dimensional semiconductors, but lacks an industrially viable, scalable, and efficient implementation, as existing approaches typically rely on post-growth processes. The present invention addresses these challenges through a transfer-free method that introduces strain in two-dimensional materials directly during their growth on a deterministically patterned thin film on the target surface. By leveraging thermal expansion mismatches within the nanostructured stack, the method deterministically engineers both strain levels and orientations through controlled surface topographies. This approach eliminates lithographic damage and transfer-related contamination while enabling precise, reproducible strain control in grown monolayers, creating clean semiconductor interfaces essential for next-generation nanoelectronic devices.

Advantages

•Elimination of transfer-related contamination, defects, and air traps. Clean, conformal semiconductor/dielectric interfaces for reliable transistor architectures.
•Deterministic, versatile strain and bandgap control compatible with standard CMOS workflows.
•Mobility enhancement and low-off-current operation enable higher drive current, lower-voltage logic, and energy-efficient portable and data-centre electronics.
•Enhanced sensor speed and sensitivity through increased surface-to-volume ratio and precise bandgap engineering for optical, chemical, and biological sensors.
•Flexible- and transparent-substrate compatibility for foldable, wearable, and see-through form factors.

Industrial Applications

•Advanced logic and memory: Strained transistors for CMOS processors, floating-gate devices, logic-in-memory logic, low-power AI and neuromorphic computing.
•Flexible and wearable electronics: Foldable displays, wearable health monitors, and conformable devices.
•Transparent electronics: Smart windows, head-up displays, and integrated displays.
•Sensors: Fast optical, chemical, and biological sensors for diagnostics, environmental monitoring, and security.
•Optoelectronics: Photodetectors, LEDs, and laser diodes with tuneable bandgaps.