A Route Towards III-V Energy Harvesting and Optoelectronic Devices on Arbitrary Substrates

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We demonstrate the versatility of a previously developed low-cost compound semiconductor growth technique termed thin-film vapor-liquid-solid[1,2] (TF-VLS) growth. Specifically, we show a variety of optoelectronic and energy devices with geometries and material combinations unavailable to traditional vapor-phase growth techniques. Critically, this is enabled by the confinement of a *liquid metal* solvent layer, enabling precise control over the position and shape of nuclei on non-epitaxial and hetero-epitaxial substrates. Unlike vapor-phase processes, in which control over the shape of a growing nuclei is extremely challenging and primarily defined by the growth rates of various crystal facets, the TF-VLS process enables full control over nuclei, enabling single crystal electron and photon devices regardless of substrate microstructure. In particular, we demonstrate both single-crystalline and poly-crystalline devices for energy harvesting devices as well as generation and detection of light.

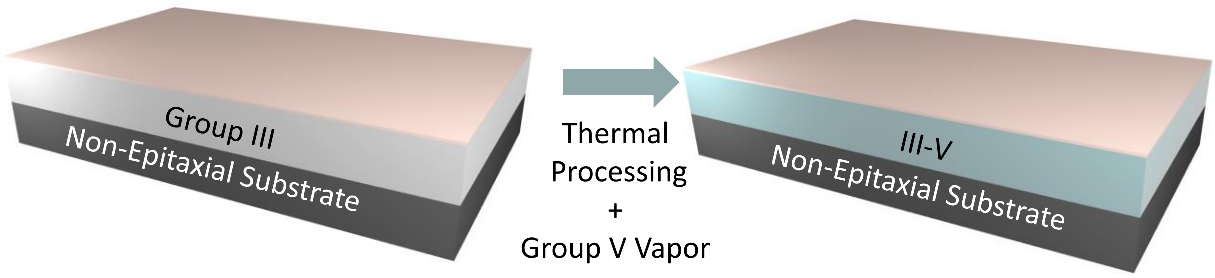

Fig. 1. Schematic View of Growth

As shown in figure one, a group III solvent layer is deposited on a user-defined substrate, followed by a heat treatment in an ambient environment of the desired vapor. This results in a supersaturation of the group III liquid and resultant precipitation of the III-V materials. In addtion to thin films, patterned group III templates give rise to high-quality micro- and nano-structure Importantly, the resulting films show excellent optoelectronic properties on par with commercially available single crystalline materials and devices.

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References

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