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In-plane Enhanced Epitaxy for Step-flow AlN Yielding High-performance Vacuum-Ultraviolet Photovoltaic Detector

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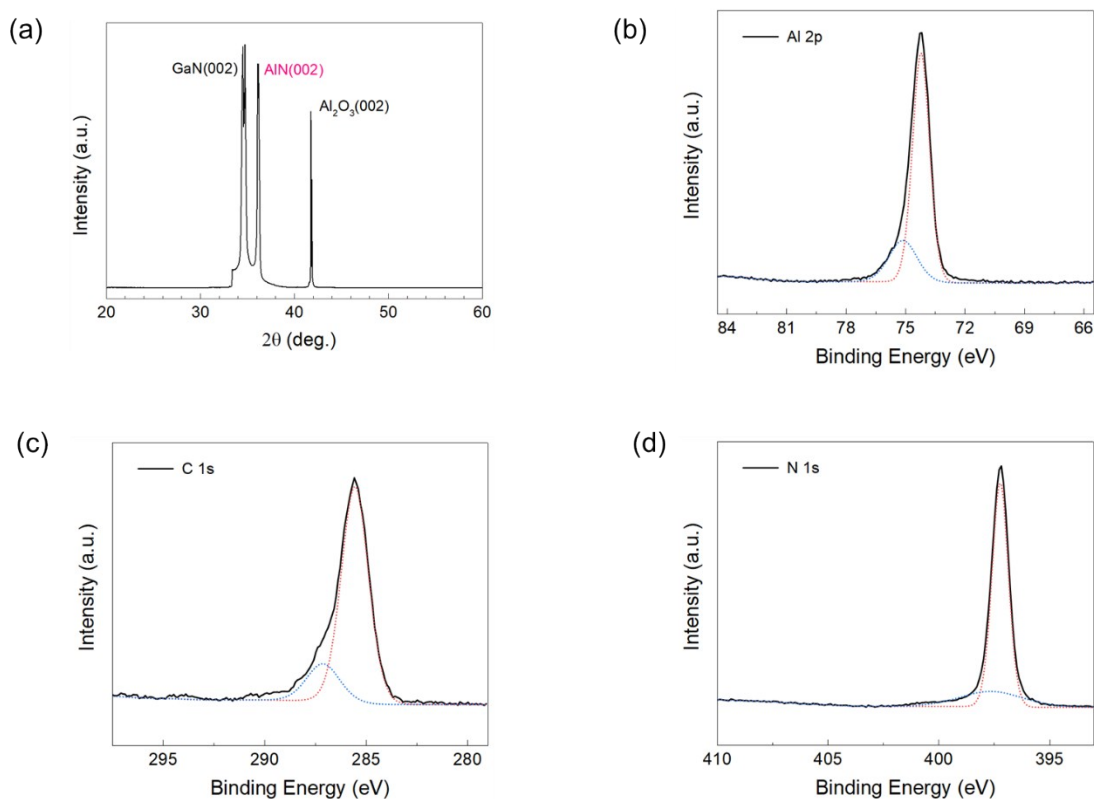


Figure S1. (a) X-ray diffraction (XRD) pattern of (002) plane of an AlN film deposited on GaN template, which shows a strong and narrow diffraction peak, indicating a single crystal orientation and a large grain size. (b)-(d) X-ray photoelectron spectroscopy (XPS) of the graphene/AlN heterojunction. The characteristic peaks of (b) C 1s, (c) Al 2p and (d) N 1s are observed, among which the C 1s peaks come from graphene.

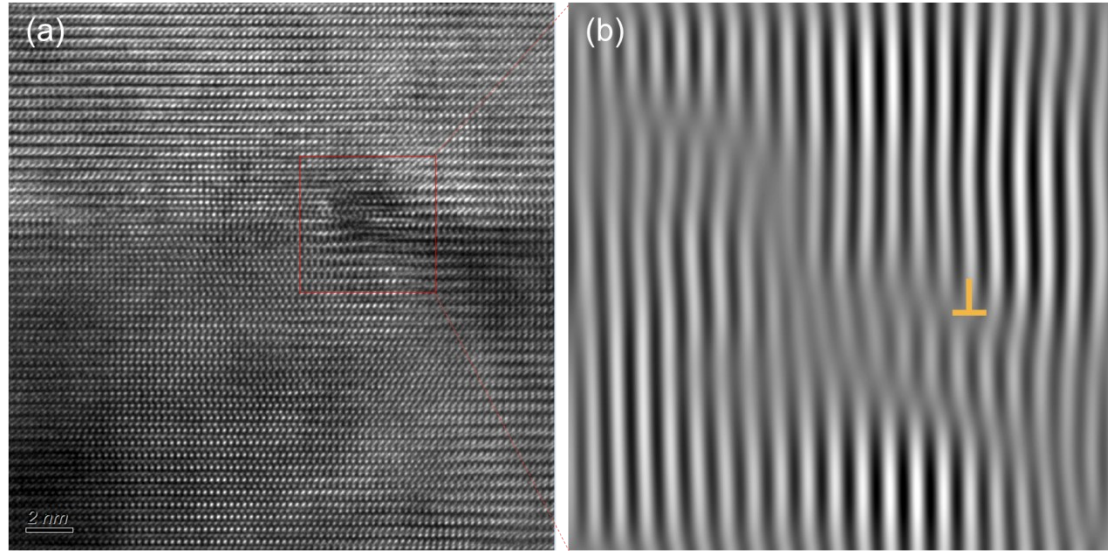


Figure S2. (a) Cross-sectional HRTEM image of the AlN/GaN interface. (b) Filtered images from masked fast Fourier transformation of selected area in (a) showing misfit dislocations.

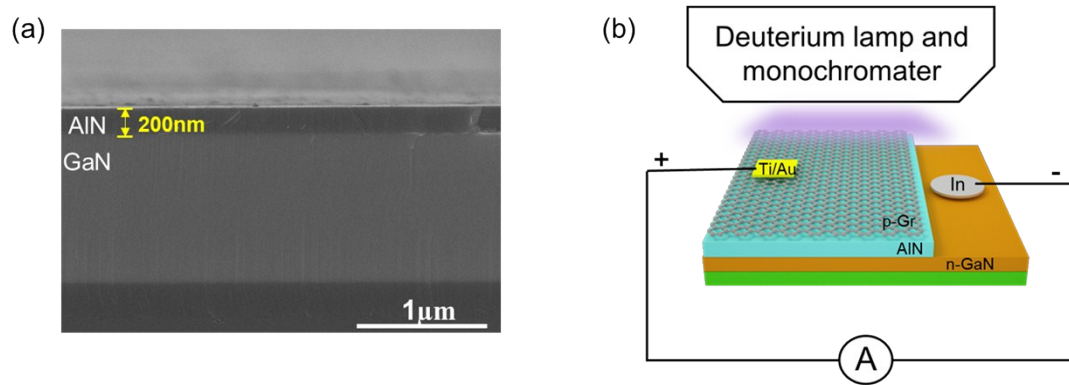


Figure S3. (a) Scanning electron microscope (SEM) cross section image of the AlN/n-GaN heterojunction, where the thickness of the AlN single crystalline film is clearly observed to be 200 nm. (b). Schematic diagram of the VUV-selected photo-response of p-Graphene/AlN/n-GaN photovoltaic detector, measured by combining monochromator with deuterium lamp. Wavelength-dependent photoresponsivity (R_λ) curve is basing on continuous adjustable monochromatic light from deep-UV to VUV. R_λ represents the detection capability of the device, defined as $R_\lambda = \Delta I / PS$, where ΔI is photocurrent minus dark current, P is incident optical power density, and S is light absorption area.

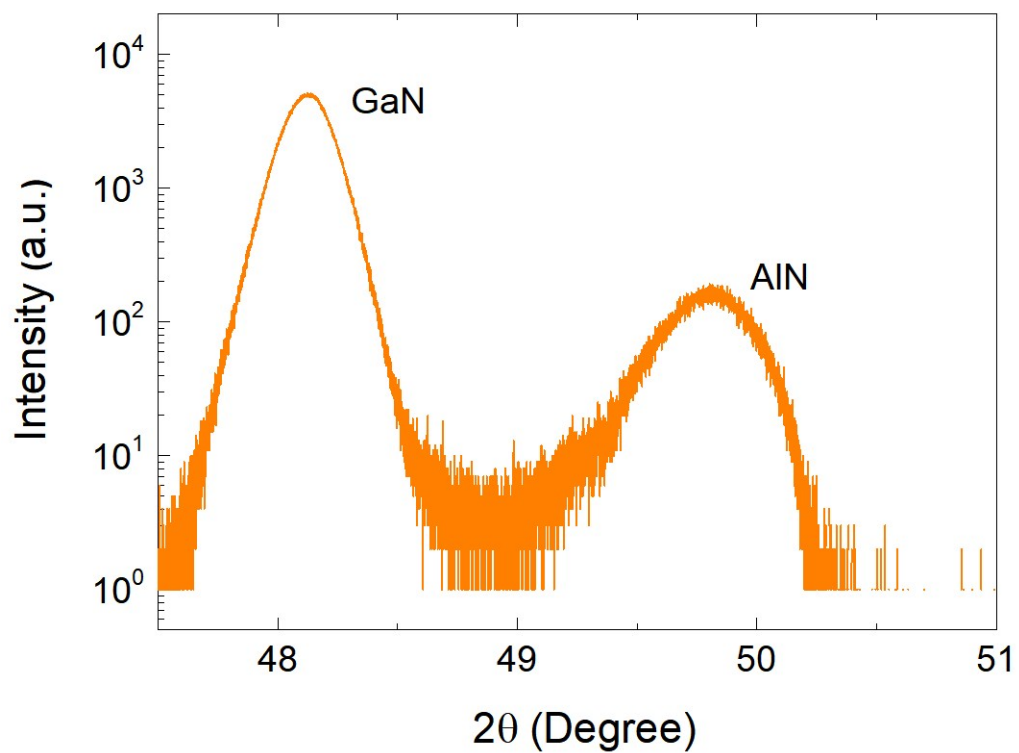


Figure S4. (a) HRXRD 2θ - ω scan of $(10\bar{1}2)$ plane of the AlN/GaN heterojunction, indicating a good crystallinity and smoothness of the interface.