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Electronic Supporting Information

Flexible Single-Crystalline GaN Substrate by Direct Deposition of III-N Thin Films on Polycrystalline Metal Tape

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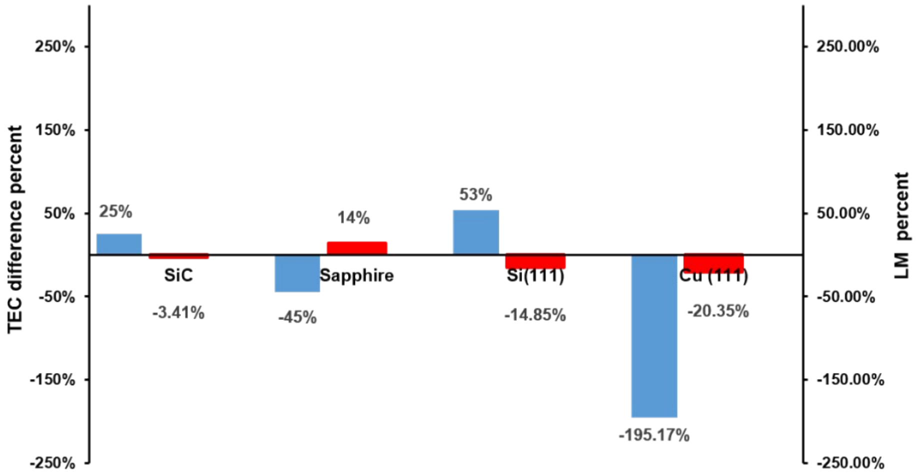

Figure S1 Differences in thermal expansion coefficient (TEC) and mismatches of in-plane lattice parameters, *a*, between a GaN layer and SiC, sapphire, Si (111), and Cu (111) substrates. The TEC differences are calculated using a formula, $-(\alpha_S - \alpha_L)/\alpha_L$, where α_S and α_L are linear TECs of the substrate and layer. The lattice mismatches (LMs) are calculated using a formula, $(a_S - a_L)/a_L$, where a_S and a_L are bulk lattice parameters of the substrate and layer (before epitaxial growth).

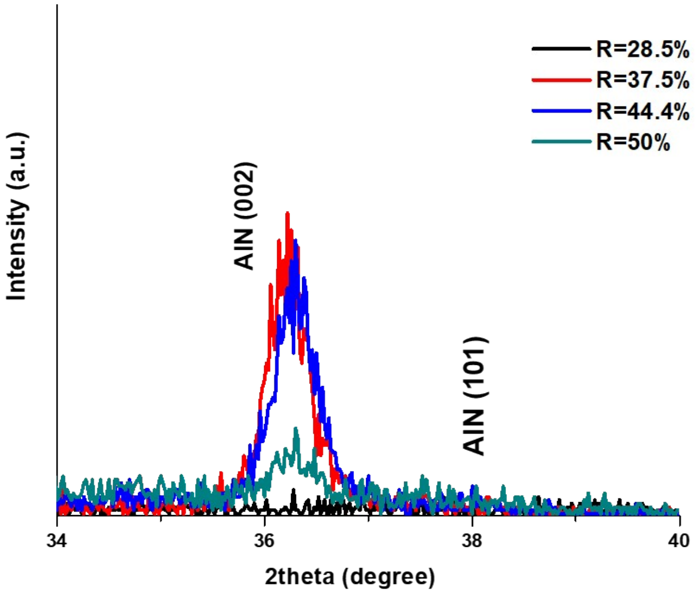

Figure S2 X-ray diffraction (XRD) 2ϑ-ω scans for AlN layers deposited at different values of the reactive gas ratio, *R* on Si (100) substrates. At *R* = ~44%, only an AlN (002) peak is measured without other peaks, indicating that the film is highly *c*-axis textured. The reactive gas ratio, defined as a ratio of reactive gas flow rate to the total gas flow rate in the plasma, is calculated by

$$R = \frac{\text{Nitrogen gas (flow rate)}}{\text{Argon gas (flow rate)} + \text{Nitrogen gas (flow rate)}} \times 100$$

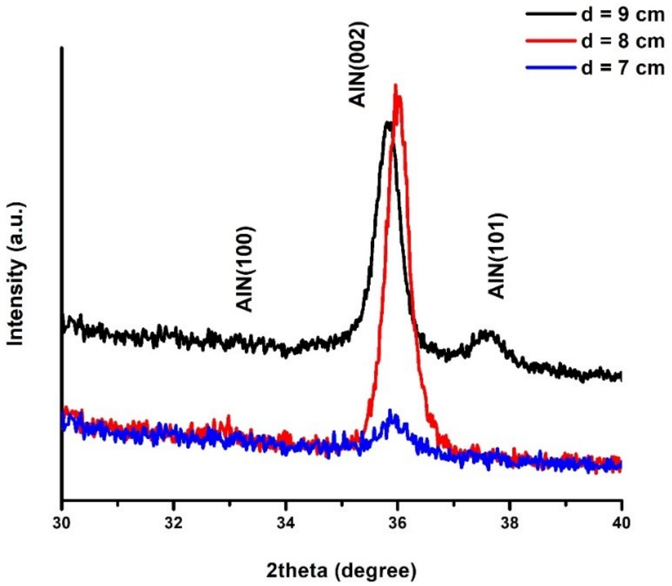

Figure S3 XRD 2θ-ω scans for AlN layers deposited at different values of the target-to-substrate distance, *d* on the Si (100) substrate with the same sputtering parameters including *R* = ~44%. At *d* = 8 cm, only a strong AlN (0002) peak is measured without other peaks, indicating that the film is highly *c*-axis textured.

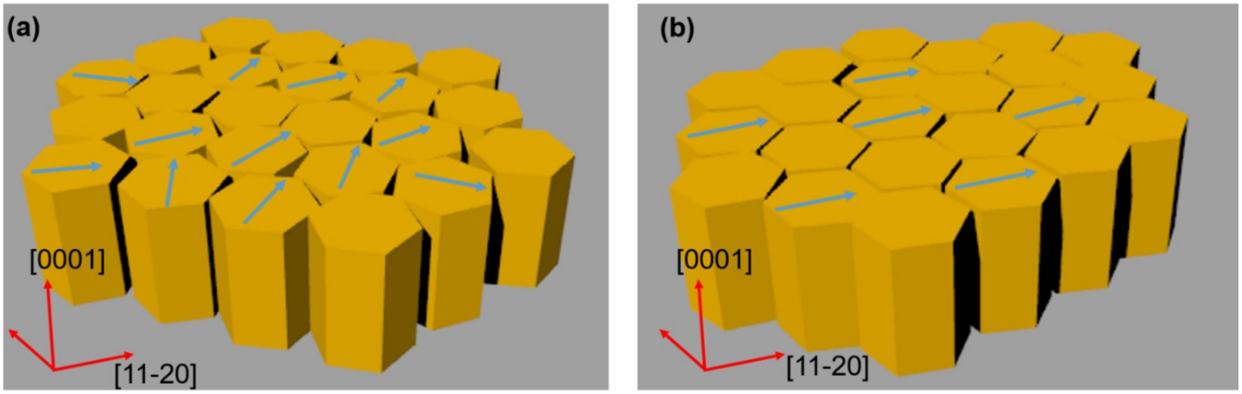

Figure S4 (a) Uniaxial and (b) biaxial alignments of crystal grains of a wurtzite structured film. The perfect single-crystalline film has a biaxial alignment without low-angle grain boundaries.

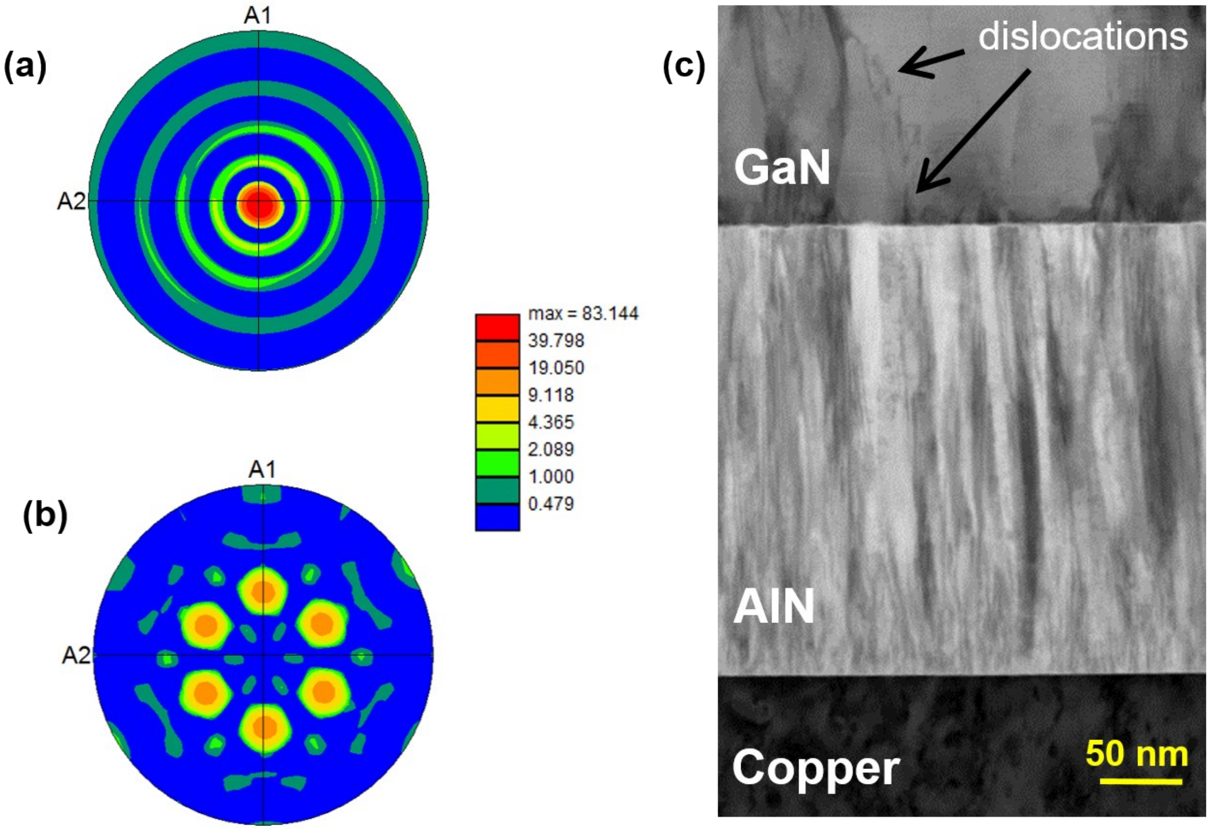

Figure S5 EBSD pole figures of (a) GaN (0001) plane and (b) GaN $\{10\bar{1}2\}$ plane. A high-quality single-crystalline GaN layer is confirmed by a small spot in the center of the axes for the GaN (0002) scan and the six-fold rotational symmetry in GaN $\{10\bar{1}2\}$ pole figure. (c) Cross-sectional TEM image of GaN and AlN on Copper.