Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supporting Information: Top-down fabrication of ordered arrays of GaN nanowires by selective area sublimation

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Scanning electron micrograph of a representative patterned field

Figure S1(a) presents representative scanning electron micrographs of a patterned field prior to selective area sublimation. The nominal values of the diameter and separation of the Si_xN_y patches for this particular field are 50 and 100 nm, respectively. As can be observed, the Si_xN_y patches have a circular shape and they are arranged in form of a hexagonal array.

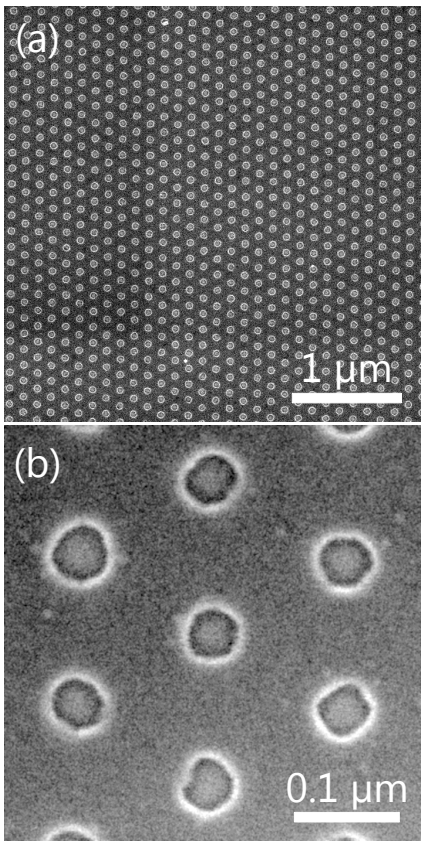

Figure S1: (a) and (b) Scanning electron micrographs with different magnifications of a field patterned with Si_xN_y patches with a nominal diameter of 50 nm and a distance between patches of 0.1 µm. The scale bars in (a) and (b) represent 1 µm and 100 nm, respectively.

Analysis of reflection high-energy electron diffraction patterns

The formation of faceted islands during the thermal decomposition of a GaN layer in vacuum for 20 min is detected *in situ* by reflection high-energy electron diffraction (RHEED). Figures S2(a) and S2(b) present, respectively, the RHEED patterns recorded along the $[11\bar{2}0]$ and $[1\bar{1}00]$ azimuths after the thermal decomposition process. Besides the GaN diffraction spots, we observe the formation of extra chevrons for both azimuths. The chevrons are longer and brighter in the case of the $[11\bar{2}0]$ azimuth. These features, caused by the refraction and diffraction transmission of the electron beam through crystal facets, can be used to derive the facet normals of the objects from which they orig-

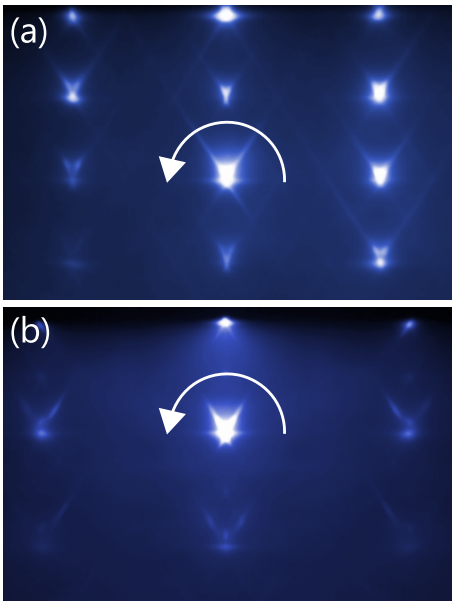

Figure S2: (Color online) RHEED patterns acquired along the [11$\bar{2}$0] and (b) [1$\bar{1}$00] azimuths after decomposing a GaN layer for 20 min at 825 °C. The white arrows schematically illustrate how the angular RHEED intensity profiles shown in Fig. S3 are extracted.

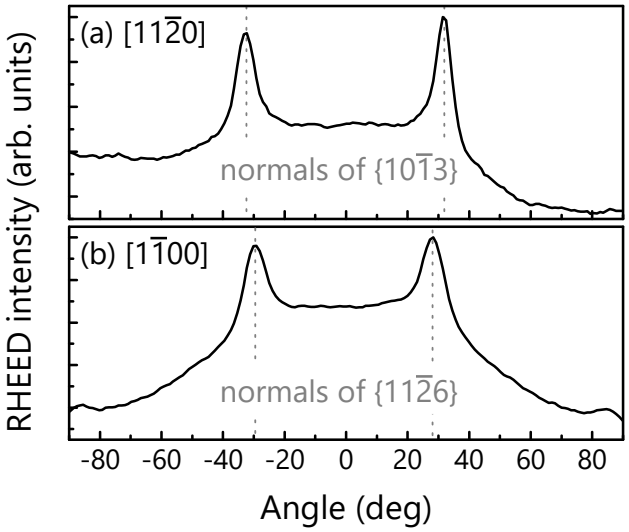

Figure S3: Angular profiles of the RHEED intensity around selected GaN diffraction spots (see Fig. S2) for the (a) [11$\bar{2}$0] and (b) [1$\bar{1}$00] azimuths. The [0001] axis corresponds to 0 °.

inate by analyzing the vertex angles.[1–6]

As explained in Ref. 6, the vertex angles reflect the projected cross-sectional shape of the three dimensional islands along the observed azimuth. Figures S3(a) and S3(b) show the plots of the angular profile of the RHEED intensity around a selected GaN diffraction spot (as indicated by the white arrows added to the RHEED patterns shown in Fig. S2) for the two main azimuths. The vertex angles extracted from the plots are 64.4 and 57.9° for the [11$\bar{2}$0] and [1$\bar{1}$00] azimuths, respectively. In the former case, half of the value of the vertex angle is 32.2°. Within experimental accuracy, this value is identical to the theoretical angle between the normal vectors of the {$\bar{1}$03} and (0001) planes (32.0°). In the case of the [1$\bar{1}$00] azimuth, the half value of the vertex angle is 29°, which compares well to the theoretical angle between the normal vectors of the {1$\bar{2}$06} and (0001) planes, namely, 28.5°. These angles reveal that the facets of the islands observed *ex situ* by scanning electron microscopy after the thermal decomposition process (see Fig. 3 in the main manuscript) are {1$\bar{1}$03} planes, as schematically illustrated in Fig. S4(a). The chevrons seen in Figs. S2(a) and S2(b) can thus be explained as follows. For the [11$\bar{2}$0] azimuth, the electron beam sees the projection of the islands as illustrated in Fig. S4(b). The corresponding chevrons are caused by electrons traveling parallel to the (1$\bar{1}$03) and ($\bar{1}$103) planes that are refracted into the islands before escaping through the (10$\bar{1}$3) and (0$\bar{1}$13) facets, respectively. For the [1$\bar{1}$00] azimuth, the projection of the islands seen by the electron beam is as shown in Fig. S4(c). The chevrons observed along this azimuth are due to electrons that strike and pass through either the ($\bar{1}$013) or (01$\bar{1}$3) facets. These electrons are refracted and leave the islands from the (01$\bar{1}$3) or (10$\bar{1}$3) facets. For the refraction process in which electrons penetrate the islands through the ($\bar{1}$013) facet and exist via the (01$\bar{1}$3) one, the trajectory of the electrons is along the plane that includes the normal vectors of the ($\bar{1}$013) and ($\bar{1}$126) planes. A similar process occurs for electrons penetrating into the islands through the (01$\bar{1}$3) facet.

The combined analysis of the different RHEED patterns together with the *ex situ* observation of faceted islands with a six fold symmetry has, therefore, allowed us to unequivocally assess the orientation of the crystal facets formed during the thermal decomposition of GaN(0001) layers in vacuum.

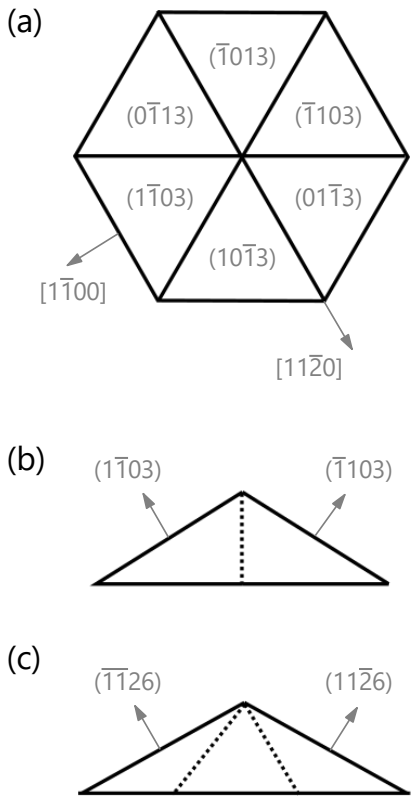

Figure S4: (a) Plan-view schematic illustration of the faceted islands formed during the sublimation of a GaN layer in vacuum. Corresponding schematic side views of the faceted islands as seen from the (b) $[11\bar{2}0]$ and (c) $[1\bar{1}00]$ directions. In (b) and (c) the arrows indicate the normal vectors of the (b) $\{\bar{1}013\}$ and (c) $\{\bar{1}\bar{1}26\}$ planes.

References

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