

## Electronic Supplementary Information

### Nano-imprinting of refractive-index matched indium tin oxide sol-gel in light-emitting diodes for eliminating total internal

*Sungjoo Kim,<sup>‡a</sup> Chul Jong Yoo,<sup>‡b</sup> Jae Yong Park,<sup>‡a</sup> Sangwon Baek,<sup>a</sup> Won Seok Cho,<sup>b</sup> and Jong-Lam Lee<sup>\*a,b</sup>*

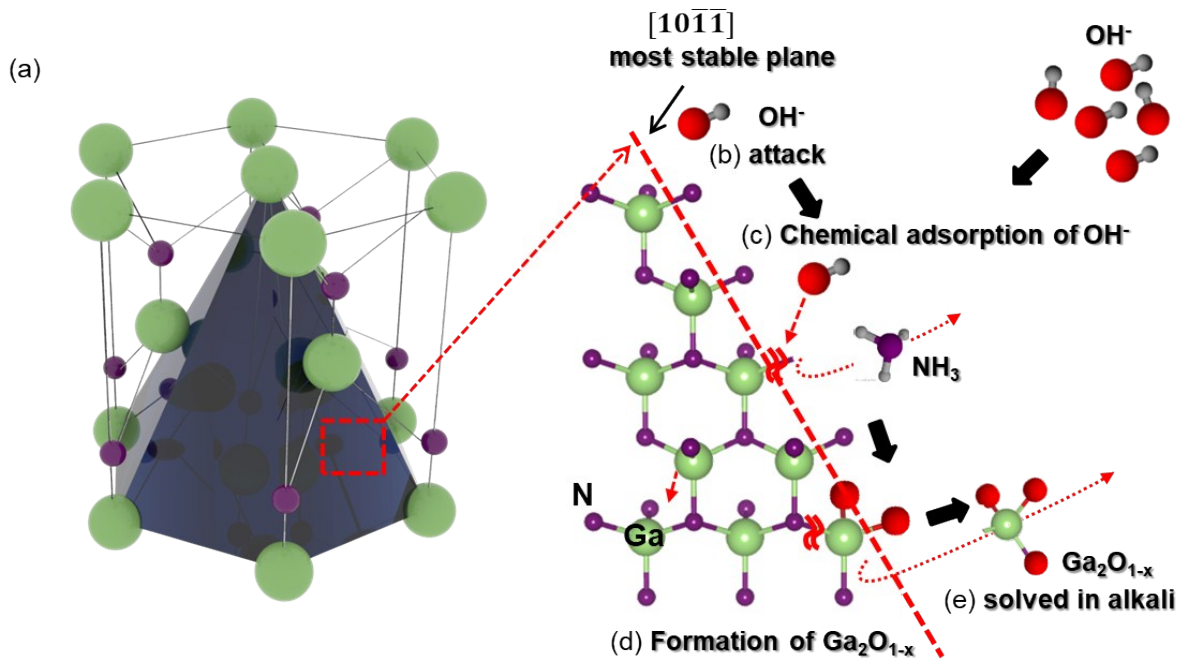
<sup>a</sup>. Department of Materials Science and Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 790-784 (Korea).

<sup>b</sup>. Division of Advanced Materials Science and Department of Materials Science and Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 790-784 (Korea).

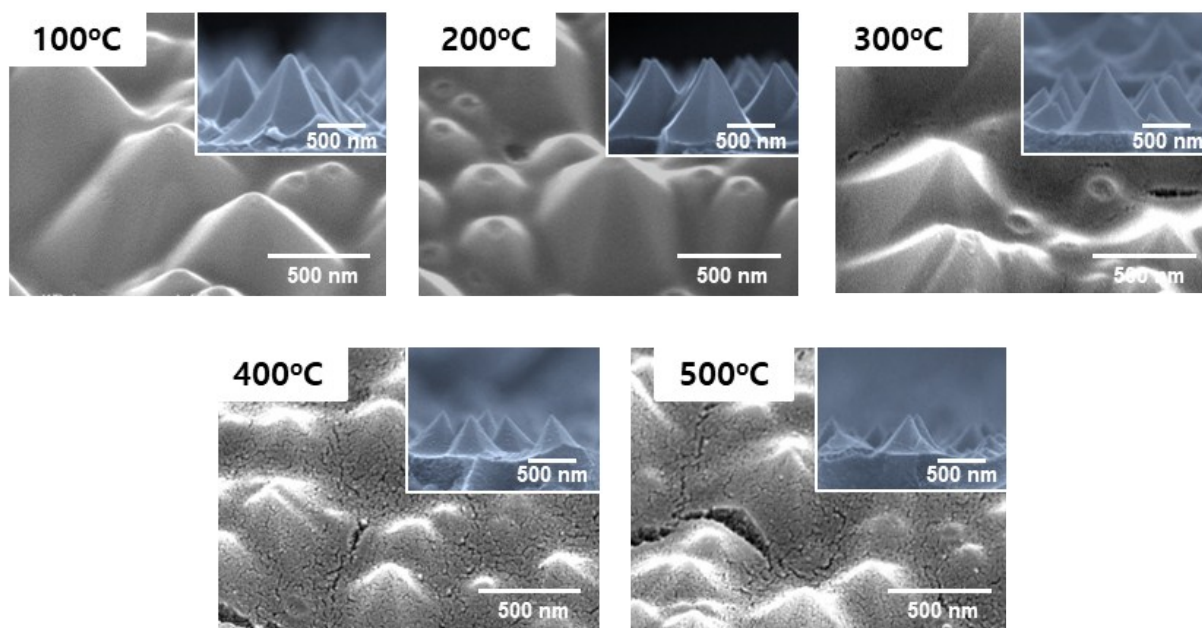
\* E-mail: jllee@postech.ac.kr

<sup>‡</sup> These authors contributed equally to this work.

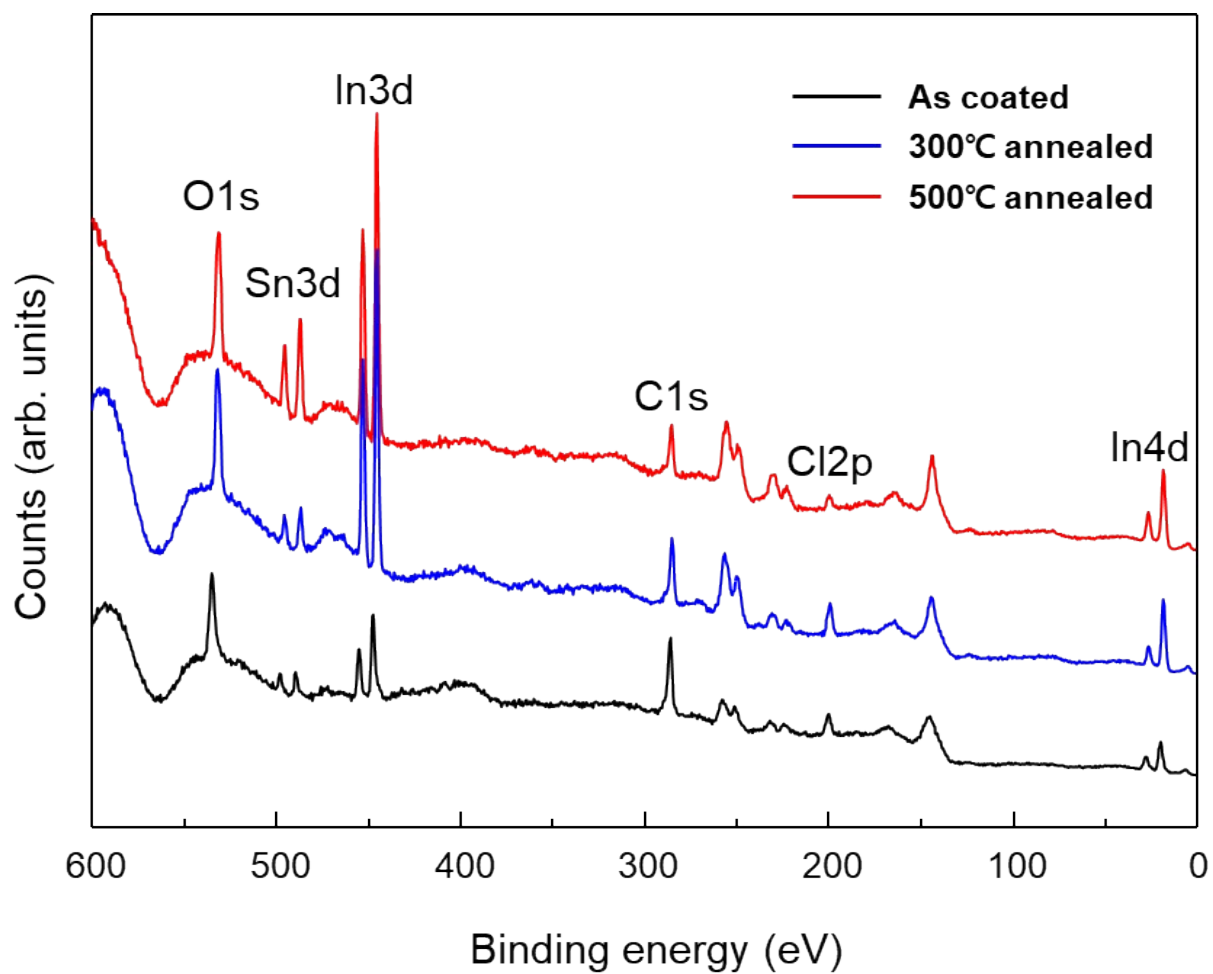
**Supplementary figures, Fig. S1-S4**



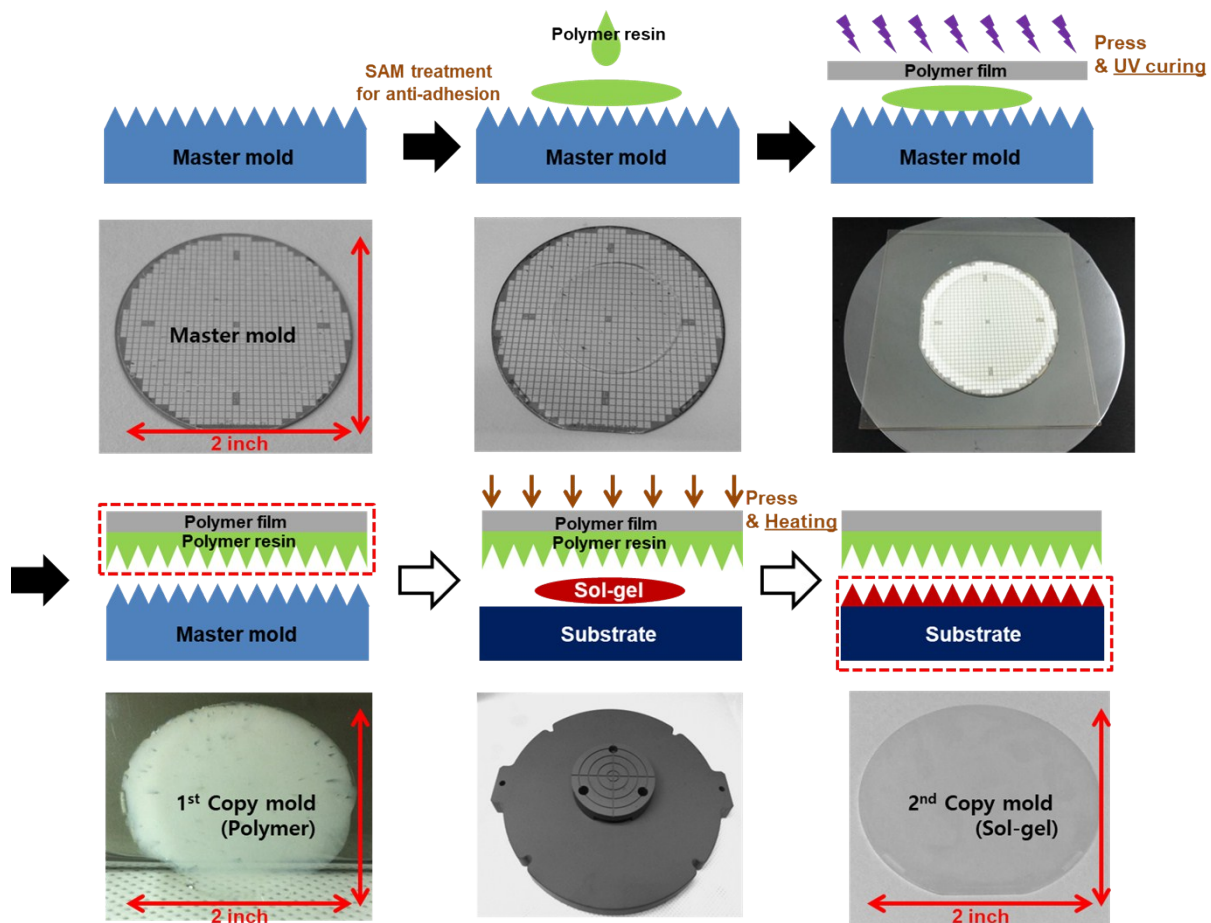
**Figure S1.** (a) Schematic illustration of photochemical etching of N polar GaN surface. (b) Nitrogen terminated layer with one negatively charged dangling bond on each nitrogen atom; (c) adsorption of hydroxide ions; (d) formation of oxides; (e) dissolving the oxides.



**Figure S2.** SEM images of nano-imprinted ITO sol-gel surfaces, as a function of the annealing temperature. The inset shows the cross-sectional images.



**Figure S3.** X-ray photoelectron spectra (wide scans) of as-coated, 300°C, and 500°C annealed ITO sol-gel films



**Figure S4.** Fabrication flow of ITO sol-gel imprint, expressed as schematic illustrations and photographs.