Supporting Information

# Correlating the Enhancement of UV Luminescence from Solution-Grown ZnO Nanorods with Hydrogen Doping

X. H. Huang,[a*] Z. Y. Zhan,[b] K. P. Pramoda,[c] C. Zhang,[d] L. X. Zheng,[b] and S. J. Chua [a,c,d*]

[a]*Department of Electrical and Computer Engineering and NUSNNI-Nanocore Laboratory National University of Singapore, Singapore 117576*

[b]*School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore 639798*

[c]*Institute of Materials Research and Engineering, 3 Research Link, Singapore 117602*

[d]*Singapore-MIT Alliance, 4 Engineering Drive 3, Singapore117576*

## Experimental details

ZnO nanorods were grown on Si (100) substrates by solution method reported previously.[1] Briefly, ZnO seed layer was prepared and spin coated onto the substrates, then the substrates were annealed in oven at 250 $^{o}$C for half an hour. The substrates were put into a growth solution consisting of 0.03 M zinc acetate with proper amount of ammonia to adjust the pH value to about 10. The growth was conducted in a water bath at 90 $^{o}$C for 1.5 hour.

The samples were characterized by scanning electron microscopy (SEM, Hitachi S4100), and high-resolution transmission electron microscopy (JEM-2010). Raman scattering spectra were recorded on Renishaw inVia Raman Microscope with a laser excitation source ($\lambda$ = 514 nm) at room temperature. Photoluminescence (PL) spectra were recorded using a micro-PL system (Renishaw Ramanscope 2000) with a He-Cd laser ($\lambda$ = 325 nm) as excitation source. Although we did not use integrating sphere, under the measurement configuration in our micro-PL system, the objective lens is quite close to the sample surface, the distance between them is about 3 mm. Therefore, most of the signals emitted from the sample surface can be collected. Under identical experiment condition, the light lost is constant fraction of the total emitted light (we define it as

* To whom correspondence should be addressed.
E-mail: xhhuang@issp.ac.cn or elehx@nus.edu.sg (X. H. Huang); elecsj@nus.edu.sg (S. J. Chua)

x%). In deriving the IQE, the ratio of intensities is used and thus this value is independent of x%. Solid-state $^{1}$H magic angle spinning nuclear magnetic resonance (NMR) measurements were carried out using a Chemagnetics spectrometer (9.4 T, 400 MHz), ZnO nanorods were loaded into 4 mm zironia PENCILTM rotors and spun at 16 kHz.

## Comparison of the UV emission from H-doped ZnO nanorods and GaN wafer

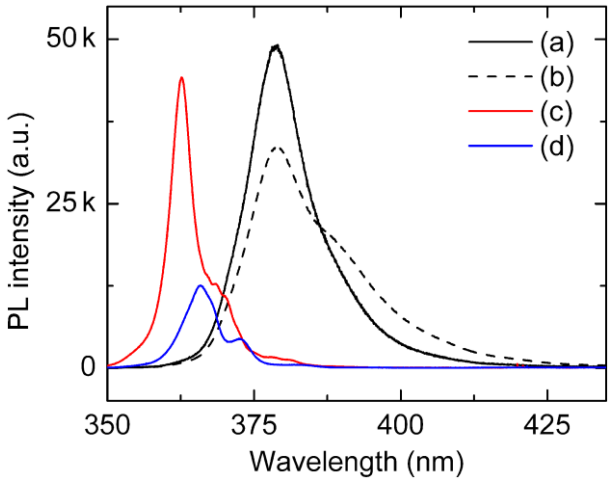


***Fig. S1*** *PL spectra of (a) ZnO nanorods after annealing in 4% $H_2$, (b) ZnO nanorods after annealing in 4% $H_2$ and aging in open air for 6 months, (c) commercial GaN film grown on sapphire, (d) GaN film grown on Si fabricated by MOCVD.*

The peak position of the UV emission from hydrogen-doped ZnO nanorods did not change with time, and the intensity showed a slight decrease during the first 1 month, and then remained stable thereafter. Even after exposing the samples in open air condition for up to 6 months, the intensity is still comparable to those from GaN film grown by metal-organic chemical vapor deposition (MOCVD), as shown in Fig. S1. We believe the intensity stability of the UV emission from hydrogen-doped ZnO nanorods can be better if the samples were kept more carefully.

## References

1. X. H. Huang, C. B. Tay, Z. Y. Zhan, C. Zhang, L. X. Zheng, T. Venkatesan and S. J. Chua, *CrystEngComm*, 2011, **13**, 7032-7036.