Electronic Supplementary Information

Island nucleation, optical and ferromagnetic properties of vertically aligned secondary growth ZnO:Cu nanorod arrays

Jun Huang, [a] Liping Zhu,*[a] Liang Hu, [a] Shijiang Liu, [b], Honghai Zhang, [a] Jie Zhang, [a] Xiaopeng Yang, [a] Luwei Sun, [a] Dehui Li [c] and ZhizhenYe [a]

[a] *State Key Laboratory of Silicon Materials, Dept. of Materials, Zhejiang University, Hangzhou, 310027, People's Republic of China. Fax: +86-571-8795 2187; Tel: +86-571-87952;*
[b] *College of Physics and Electric Information, Luoyang Normal University, Luoyang, 471022,People's Republic of China.*
[c] *National Certer of Testing Technology, Shanghai, 201203, People's Republic of China.*
E-mail:zlp1@zju.edu.cn

1. Experimental Details:

The pure ZnO buffer layer with a thickness of 300 nm was prepared on (001) silicon substrate by pulsed laser deposition (PLD) using a KrF laser operating at 248 nm and a fluence of 0.38 $J \cdot cm^{-2}$ at 500℃ (which is the optimized temperature for good *c*-axis orientation) for 30min.

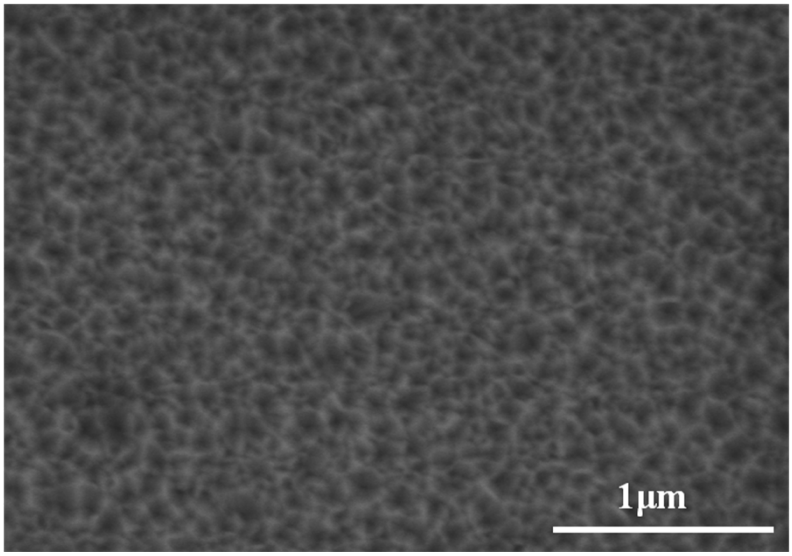

Figure S1. SEM image of the ZnO buffer layer grown on (100) silicon by PLD method.

2. Elements calculation formula for X-ray photoelectron spectrum (XPS) of the ZnO:Cu nanorod arrays:

$$X(at\%) = \frac{(A_x / S_x)}{\sum_{i=1}^{n}(A_i / S_i)} \times 100\% \qquad \text{(S1)}$$

here X stands for the element type, A_x stands for the area of the element X under a certain peak, and S_x is the sensitivity factor (Zn:4.8, O:0.66, Cu 6.3).

3. Scanning electron microscopy (SEM) and Energy disperse spectrum (EDS) measurements of the ZnO:Cu nanorods without secondary growth.

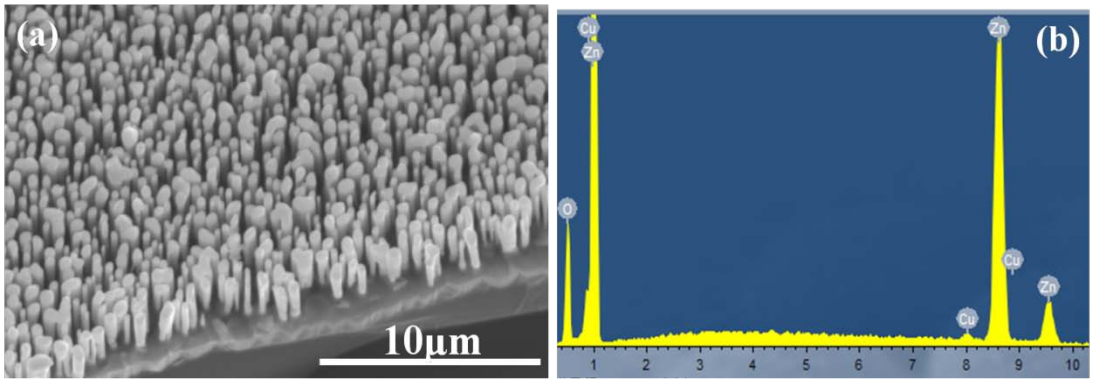

Figure S2. SEM, and EDS measurement of ZnO:Cu nanorod arrays (a) titled view image of the ZnO:Cu nanorod arrays without secondary growth, (b) EDS measurement of the ZnO:Cu nanorod arrays.

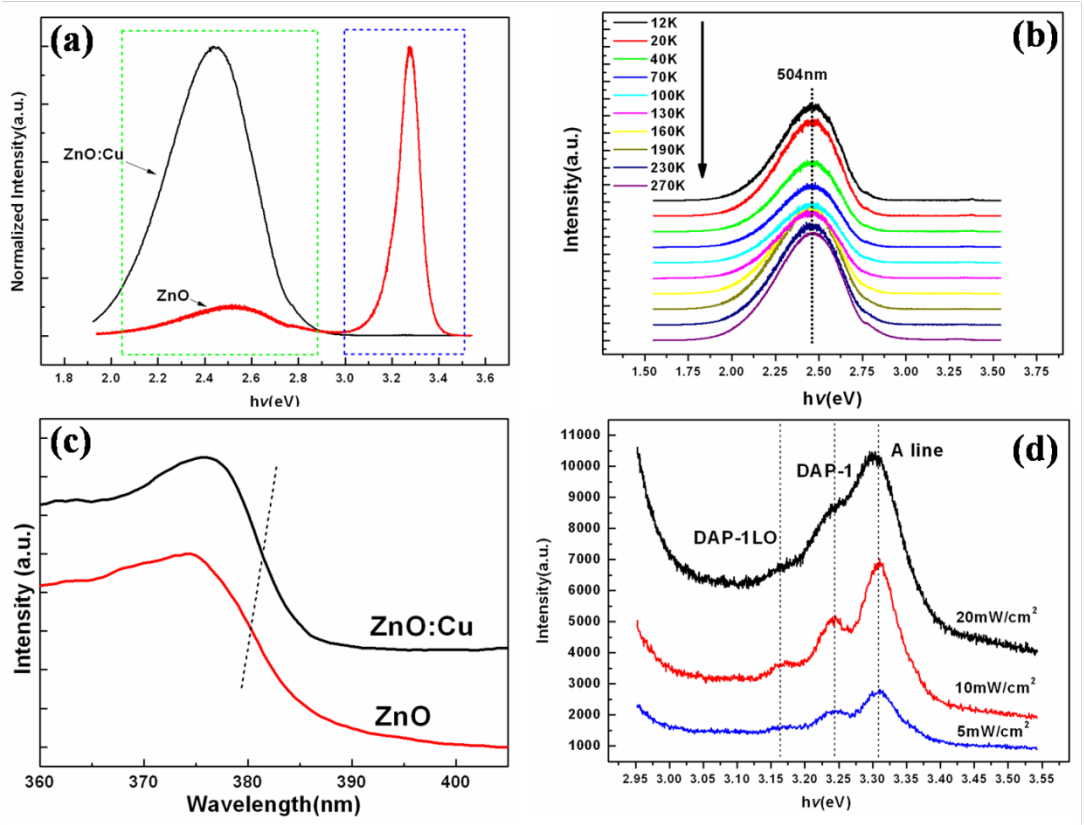

Figure S3. (a) Room temperature photoluminescence spectra of ZnO and secondary growth ZnO:Cu nanorods, (b) temperature-dependent PL spectra of Cu doped samples from 12K to 270K, (c) room temperature photoluminescence excitation (RT-PLE) spectra of ZnO and secondary growth ZnO:Cu nanorods, (d) excitation intensity changed spectra of secondary growth ZnO:Cu nanorods with different excitation powers.

4. Secondary growth for ZnO nanorods is also observed in our experiment.

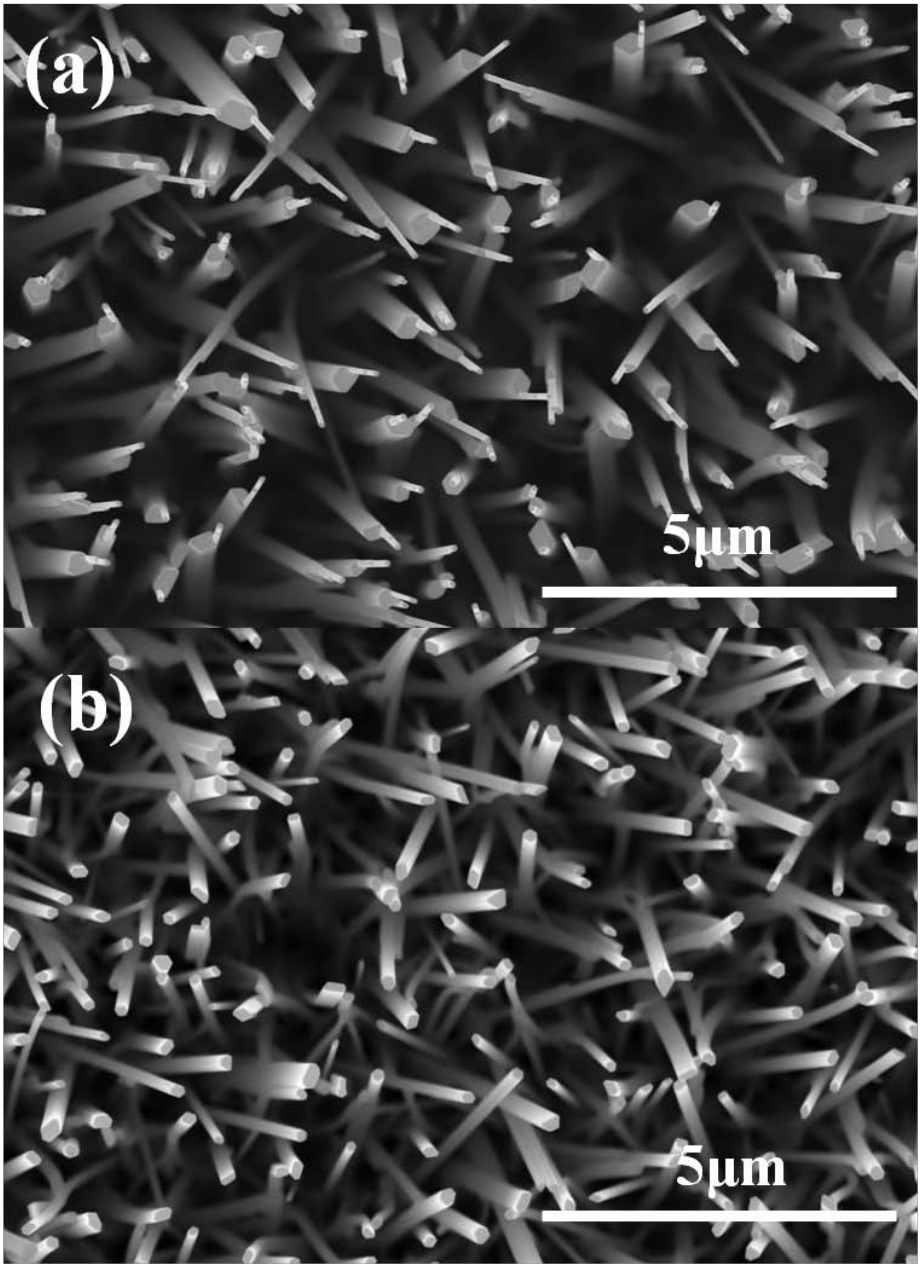

Figure S4. (a) ZnO nanorod arrays with secondary growth, (b) ZnO nanorod arrays without secondary growth.

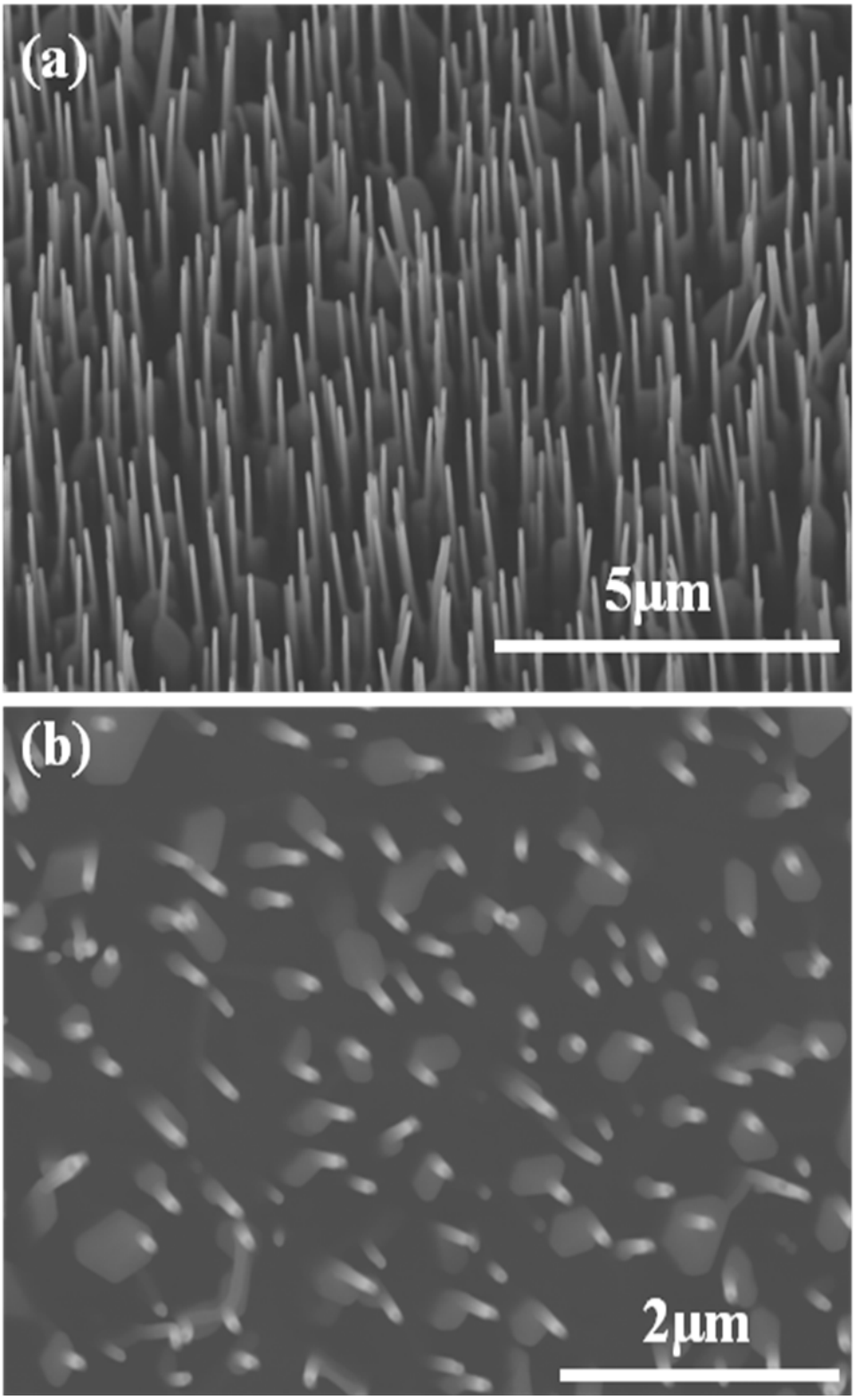

Figure S5. Secondary growth of ZnO:Cu nanorod arrays, (a) 15° tilted view SEM image,

(b) top view SEM image of secondary growth ZnO:Cu nanorods arrays

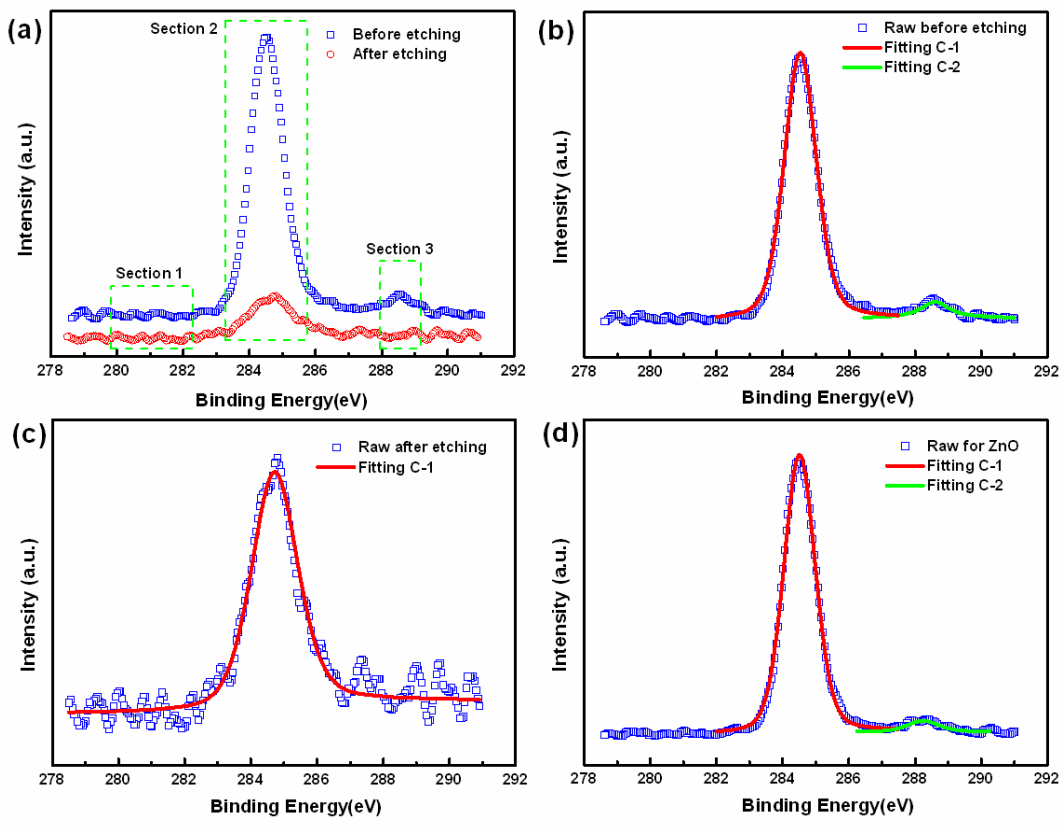

Figure S6. Slow scan of C 1s peak for ZnO and secondary growth ZnO:Cu nanorod arrays, (a) slow scan of C 1s peak for the secondary growth ZnO:Cu sample before etching and after etching, (b) fitting result of C 1s peak for the secondary growth ZnO:Cu sample before etching, (c) fitting result of C 1s peak for the secondary growth ZnO:Cu sample after etching, (d) fitting curves of C 1s peak for ZnO nanorods array

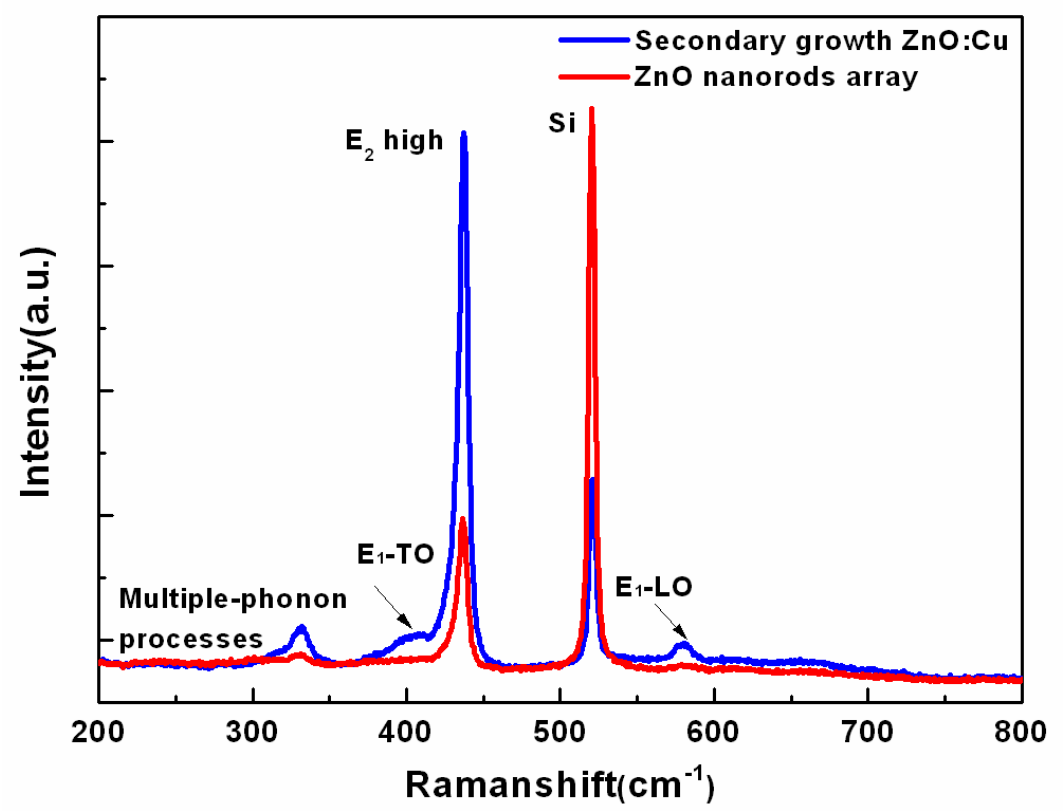

Figure S7. Raman spectrum of as grown ZnO nanorods array (the red line) and secondary growth ZnO:Cu nanorods array (the blue line).