Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information

The Defect Nature of Photoluminescence from Porous Silicon Nanowires Array

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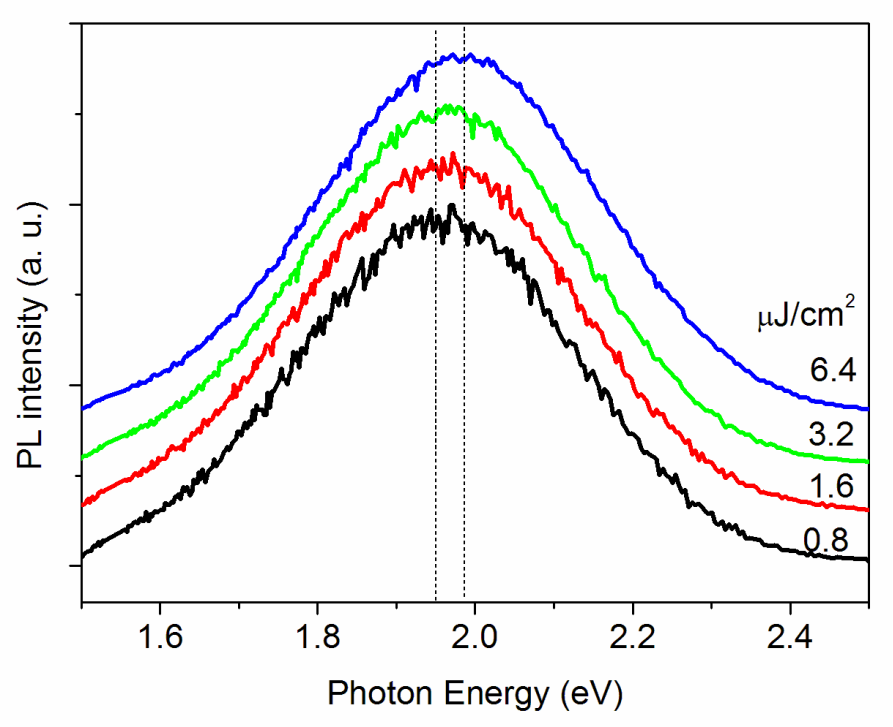

Figure S1. Excitation density-dependent PL spectra of porous Si nanowires. The spectra are excited with pulsed laser (355 nm, 1ns pulse width, 100 Hz repeating frequency) and recorded at room temperature.

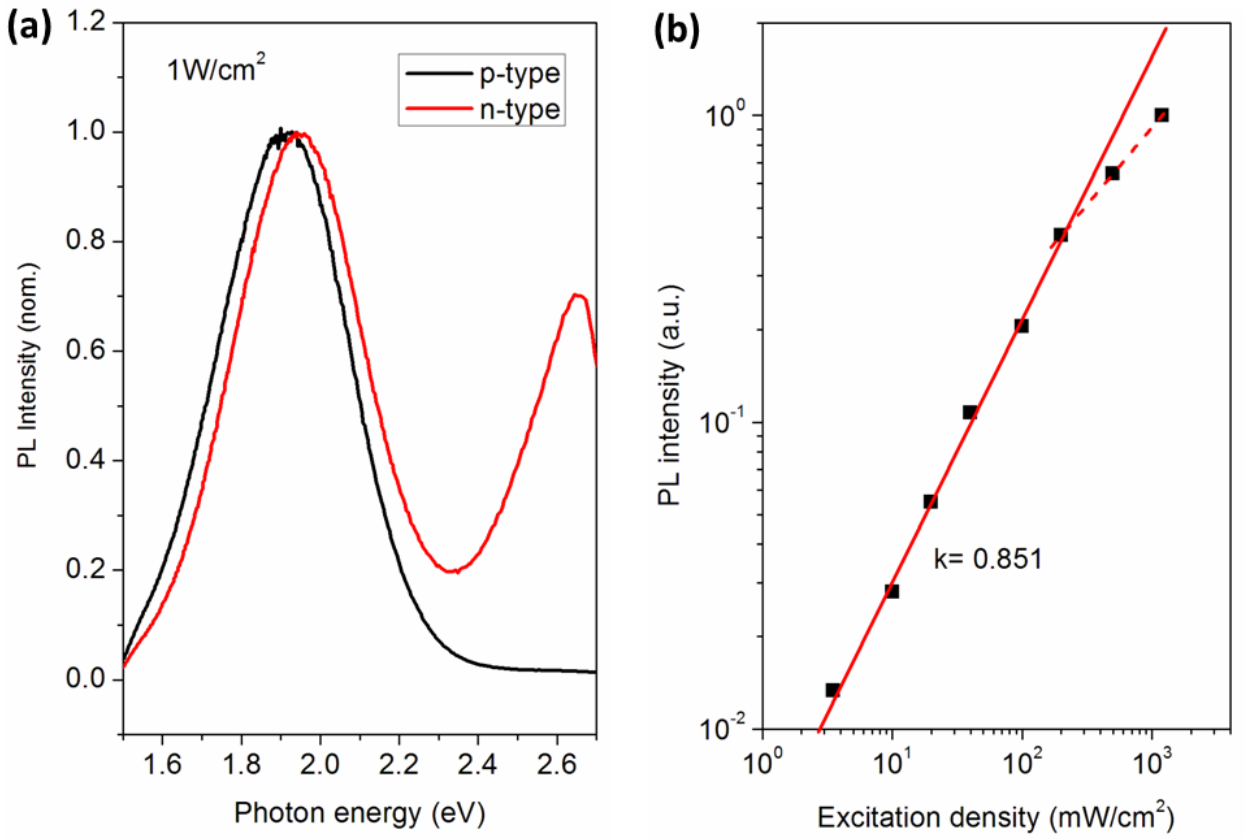

Figure S2. PL properties of porous Si nanowires staring with n-type Si wafers. (a) Room temperature PL spectra under excitation density of 1W/cm^2. The two samples show very similar PL features except for the emission from the oxidation states around 2.6 eV.[1] The assignment of 2.6 eV emission is supported by the thermal treatment experiments (see Fig. S3). (b) The integrated PL intensity as function of excitation density. The PL intensity shows power-law dependence on the excitation density with a slope of 0.851. The deviation from the power-law dependence in the higher-excitation regime is due to the saturation effect of defect-related transition.

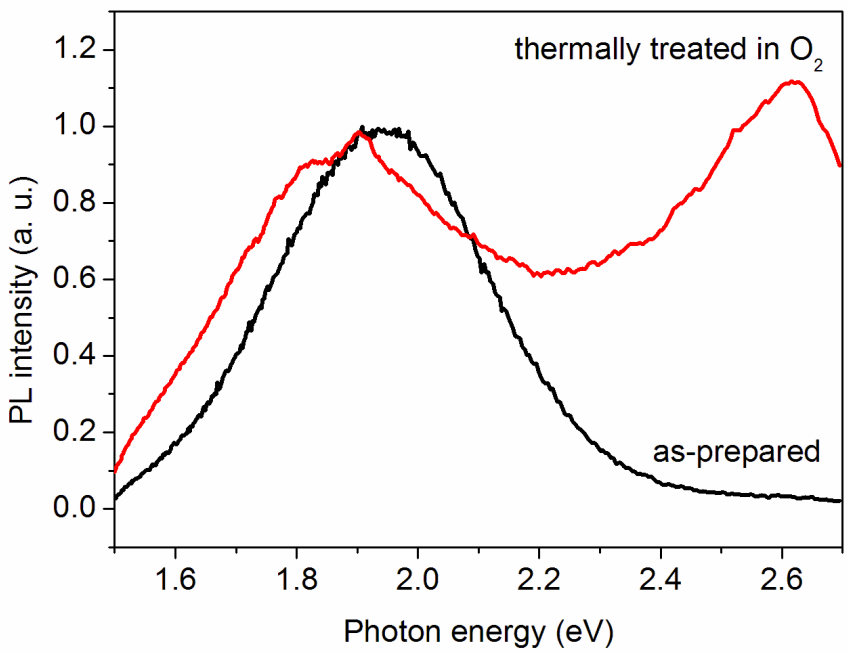

Figure S3. PL spectra of the as-prepared and thermally treated p-type Si nanowires. The thermal treatment in oxygen produces the emission around 2.6 eV, suggesting that the emission is from oxidation states. However, the degree of oxidation hence the intensity of 2.6 eV emission seems depends on the experimental details including the used wafers, which is an issue currently unclarified.

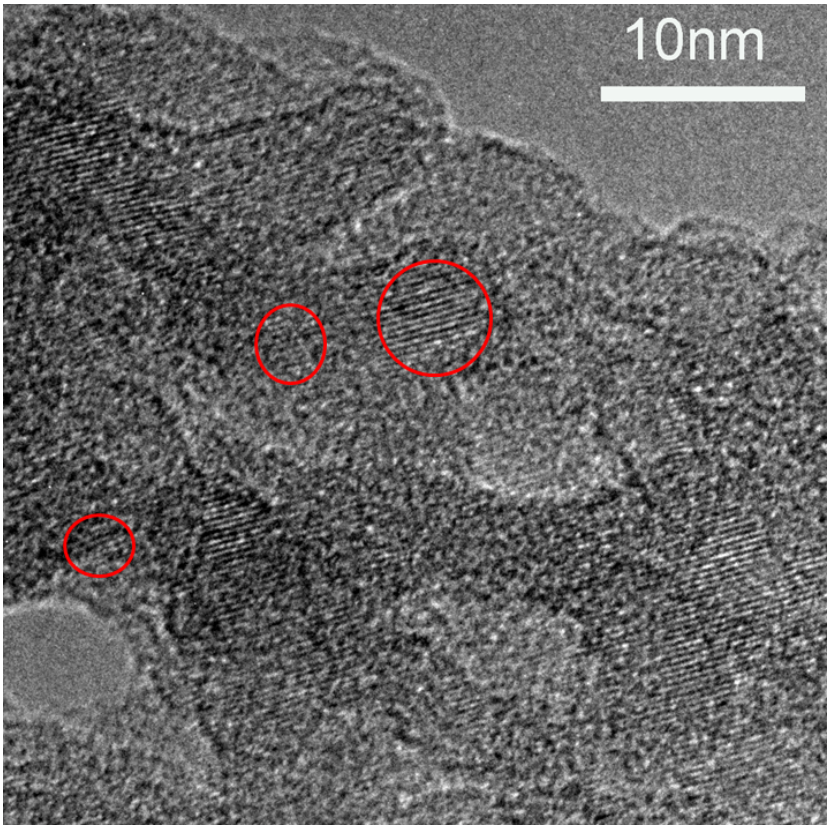

Figure S4. HRTEM image of porous Si nanowire. Red circles indicate the Si nanocrystals with different size.

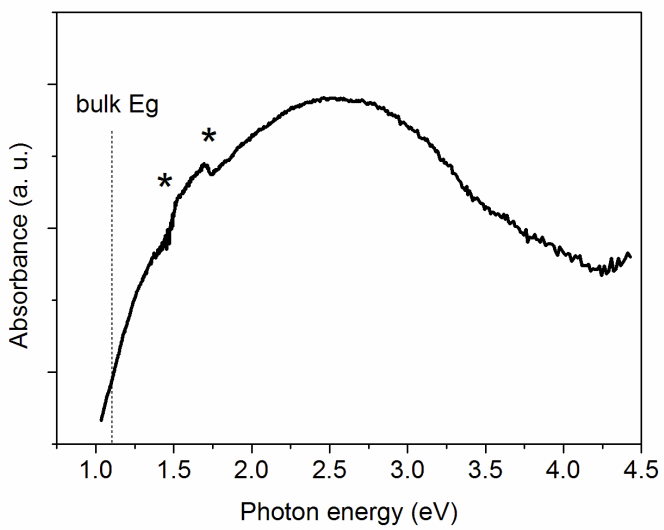

Figure S5. Optical absorption spectrum of porous Si nanowires. The nanowires were scratched from the wafer and distributed in ethanol for measurement. The sudden changes labelled by * symbol is due to equipment artifact. We find the absorption can be divided into two regions regarding the slope. The first one in the range of 1.1-1.35 eV is abrupt (but still milder than that of bulk Si), while the increase of the second one (~1.35-2.5 eV) is much milder. We suggest the two regions result from the large (bulk-like) and small Si nanocrystals, respectively. The mild and broad absorption is a result of the size (hence the bandgap) distribution of Si nanocrystals.

Reference

1. H. Tamura, M. Ruckschloss, T. Wirschem and S. Veprek, Appl. Phys. Lett., 1994, 65, 1537.