Supporting Information

High Performance H_2 Evolution Realized in 20-μm-thin Silicon Nanostructured Photocathode

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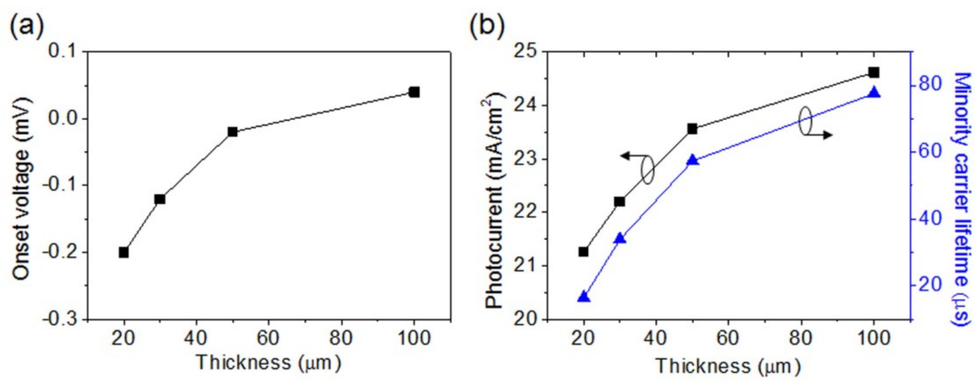

Figure S1. (a) Onset voltage (V_{ph}) for planar Si as a function of substrate thickness (W). (b) Saturated photocurrent density (J_{ph}) and effective minority carrier lifetime (τ_{eff}). Generally, τ_{eff} is expressed as follows: $1/\tau_{eff}=1/\tau_{bulk}+1/\tau_{surf}$, where τ_{bulk} is the bulk minority carrier lifetime.

Assuming that the τ_{bulk} value (~1 ms for our silicon wafers) is negligible, τ_{eff} can be approximated as τ_{surf}, i.e., $\tau_{eff} \approx \tau_{surf}$.

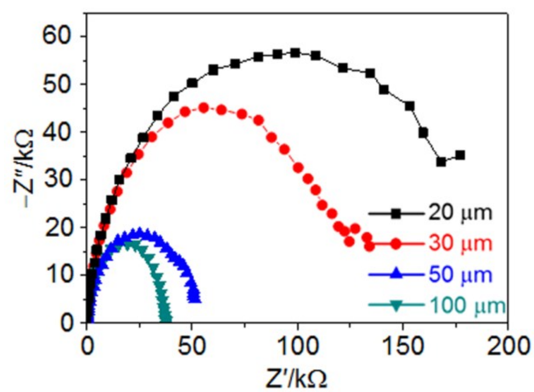

Figure S2. Nyquist plot of impedance spectroscopy data for planar Si as a function of thickness (W) at 20 μm (black), 30 μm (red), and 50 μm (blue), and 100 μm (cyan).

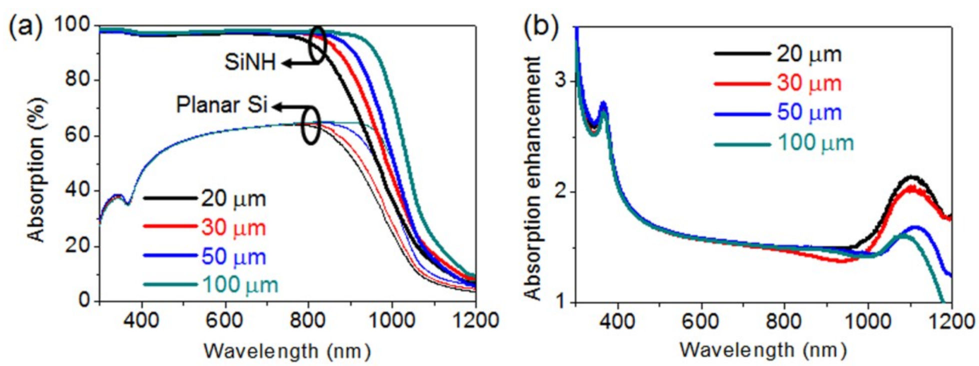

Figure S3. (a) Light absorption spectra and of Si NH (thick lines) and planar Si (thin lines) for various W values of 20, 30, 50, and 100 μm. (b) The absorption enhancement spectra of tapered SiNH with varying W. Tapered Si NH structures exhibit a gradual change of effective refractive indexes, which act as antireflective dielectric multilayers delivering superior broadband anti-reflectance.

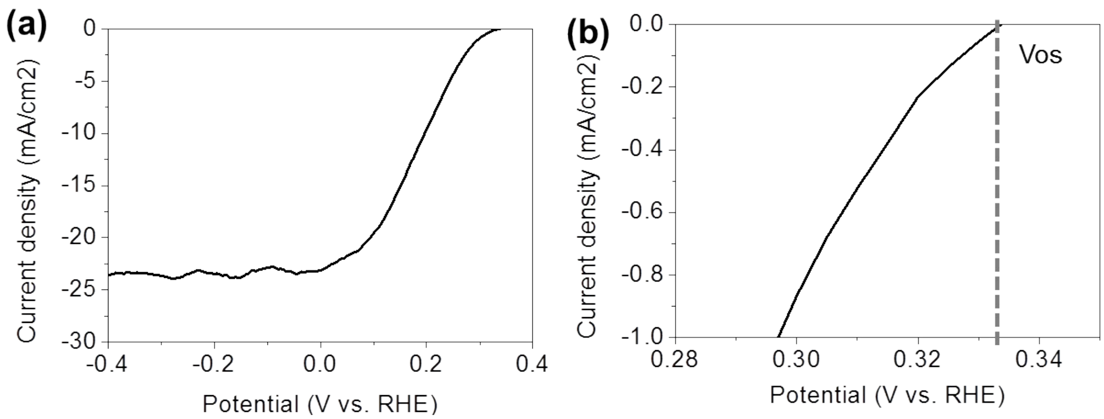

Figure S4. (a) J-V curve of Pt NPs/Si NHs photocathodes (20 μm-thick) and (b) magnification of J-V curve around the 0-1 mA/cm^2 photocurrent.

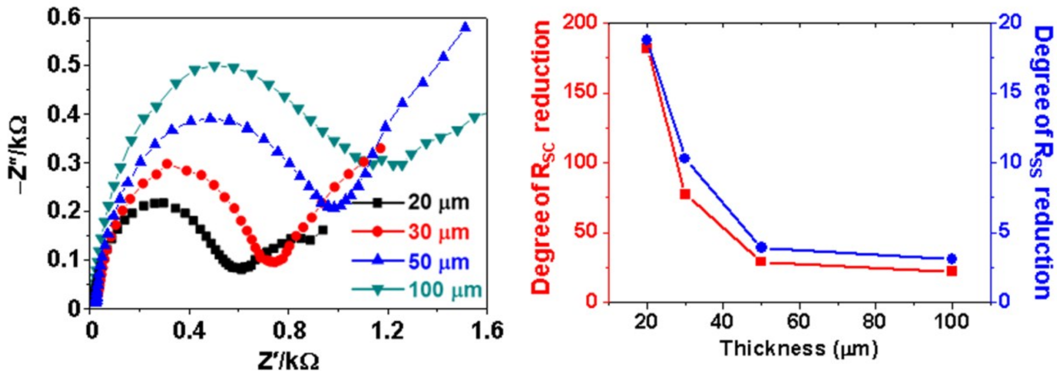

Figure S5. (a) Nyquist plots of impedance spectroscopy data for Pt NPs-planar Si as a function of W. (b) The overall amount of R_{sc} and R_{ss} reduction for planar Si after coating Pt NPs. The greatest reduction in charge transfer resistance was observed for the thinnest planar Si.

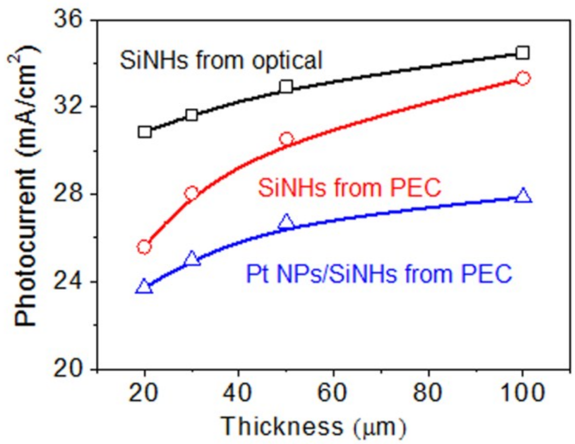

Figure S6. Saturated photocurrent values measured as a function of wafer thickness in the saturated region (1.5 V vs. RHE) of SiNHs and Pt NPs/SiNHs.

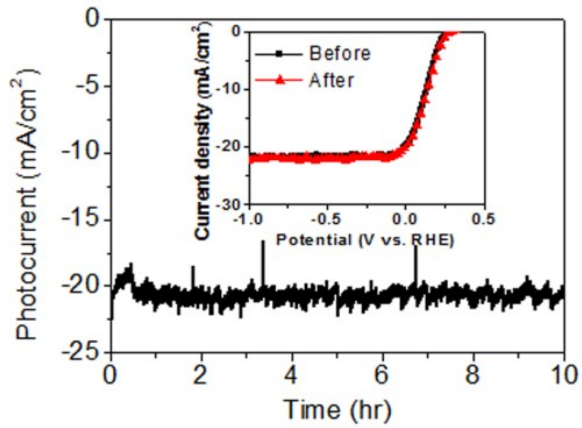

Figure S7. Long-term stability test of 20-μm-thin Si photocathode employing Pt/Si NHs at 0 V vs. RHE. Insets show J-V curves before and after the 10 hr stability test.

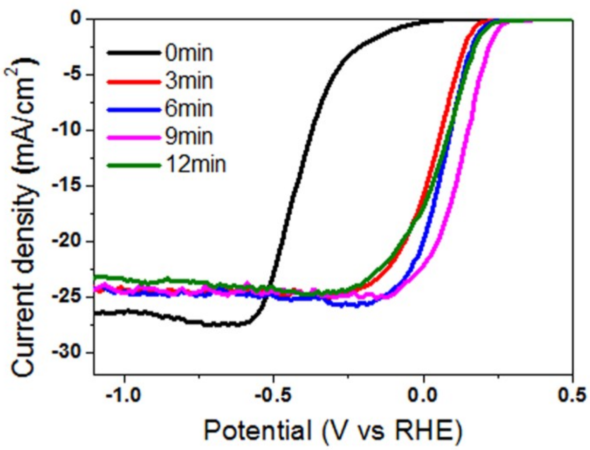

Figure S8. J-V curve of SiNH photocathode as a function of Pt deposition time.