Electronic Supplementary Information

Thorny CdSe Nanotubes via an Aqueous Anion Exchange Reaction Process and Their Photoelectrochemical Applications

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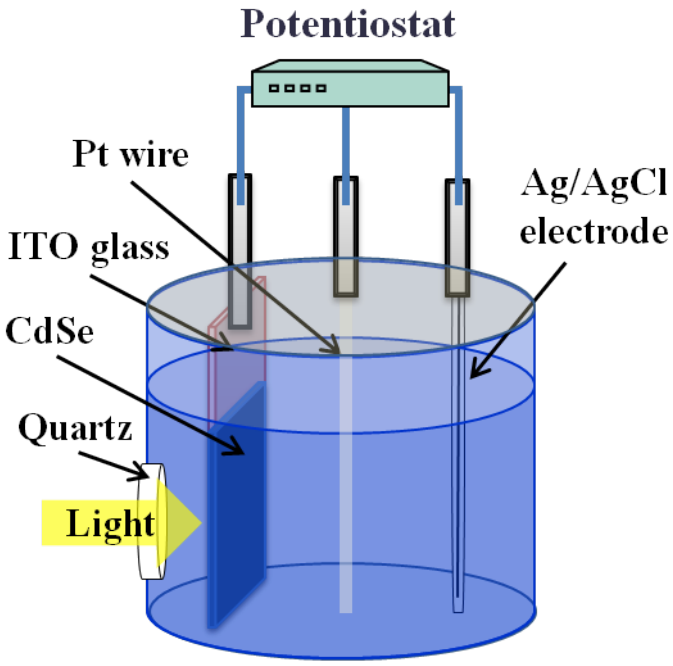
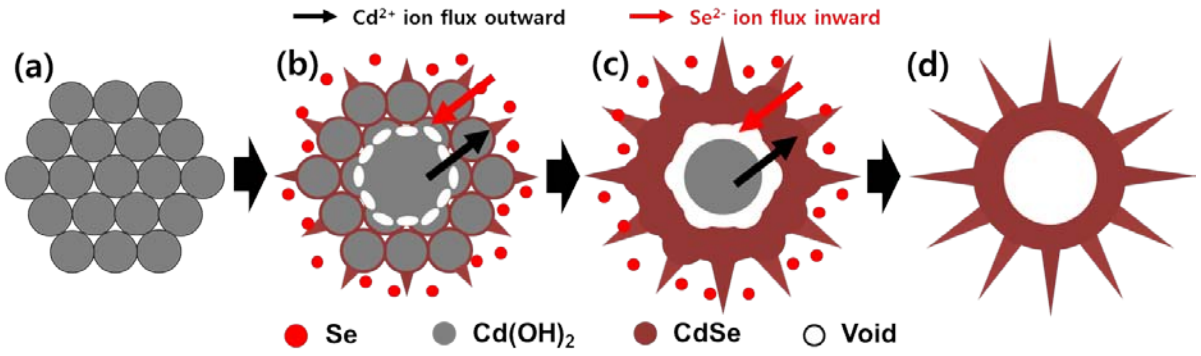


Scheme S1. Schematic diagram illustrating the fabrication of photoelectrochemical cell by using three-electrode configuration (ITO/CdSe nanostructure/poly sulfide electrolyte/Pt)



Scheme S2. Schematic diagram of the entire process via Kirkendall diffusion effect. The interdiffusion of Se^{2-} and Cd^{2+} occurs through the CdSe outer shell.

Table S1. Relative Concentration of Se and reducing agent ($NaBH_4$) and resulting morphological classification

Concentration (mM)		Se		
		5	7.5	10
$NaBH_4$	5	*Hierarchical NTs*	*Hierarchical NTs*	*Hierarchical NTs*
	7.5	*Hierarchical NTs*	*Hierarchical NTs*	*Hierarchical NTs*
	10	*Hierarchical NTs*	*Hierarchical NTs*	*Hierarchical NTs*
	15	*Hierarchical NTs*	Both NTs	Both NTs
	20	Smooth NTs	Smooth NTs	Smooth NTs
	25	Smooth NTs	Smooth NTs	Smooth NTs

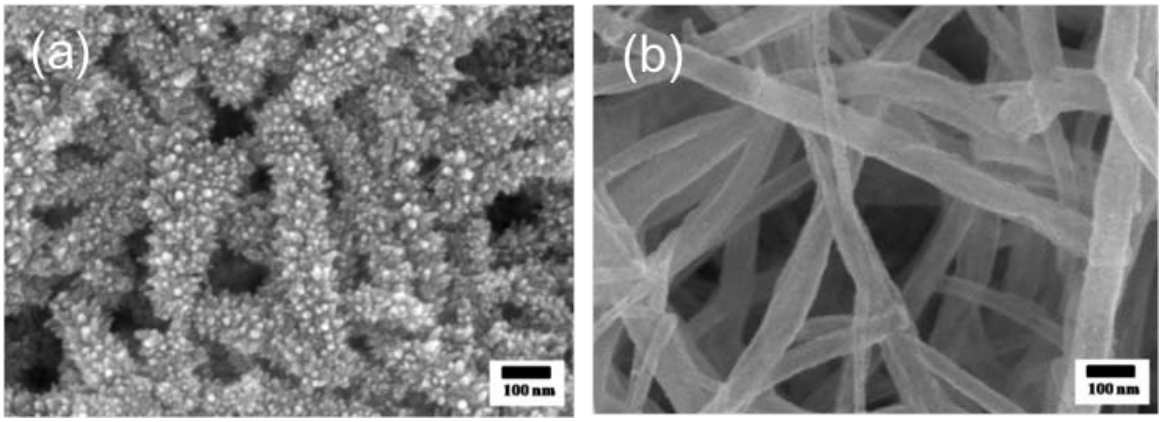


Figure S1. The surface morphology of (a) hierarchical thorny CdSe nanotubes and (b) CdSe nanotubes

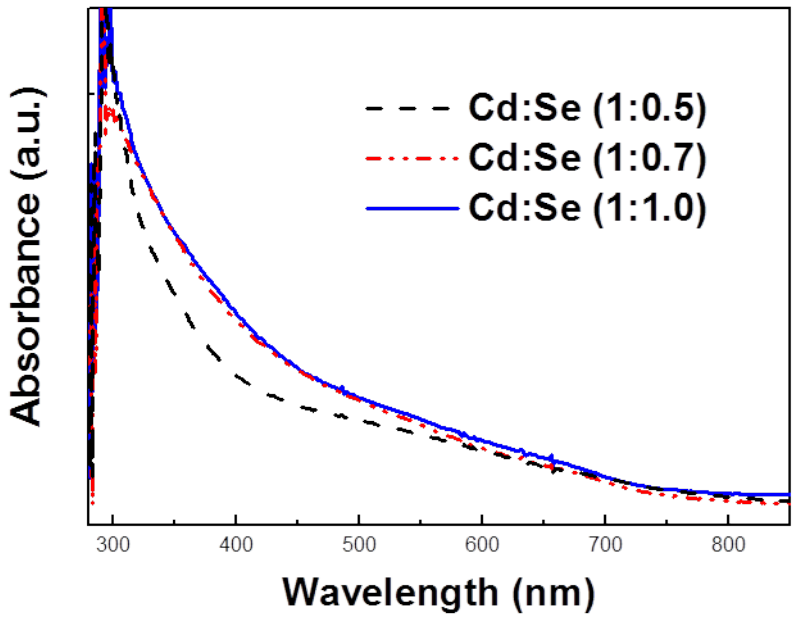


Figure S2. UV-vis absorption spectra compared with atomic ratios of the prepared thorny CdSe nanotubes.

For the electrochemical comparison between thorny nanotube and simple nanotube, the $Cd(OH)_2$ NBs as sacrificial template were synthesized on the ITO glass at 60 °C for 5 h in a bath. The simple nanotubes were obtained by converting the $Cd(OH)_2$ sacrificial template in the NaHSe aqueous solution, prepared by dissolving 10 mM of Se powder in 20 mM $NaBH_4$ solution. On the other hand, the thorny nanotubes were obtained in the NaHSe solution that contains only 10 mM $NaBH_4$ in the same Se quantity. (See the SEM iamges of Figure S1 in the Supporting Information) The reacting time of both nanotubes in the solution was equally fixed to 10 min.

We have evaluated the *I-V* measurements in dark condition as well as under 100 mW/cm^2 light produced by a 500 W Xenon lamp equipped with an AM 1.5G filter for investigation of the PEC properties of the thorny nanotubes and simple nanotubes. The Figure S3 clearly shows the photocurrent density curve versus the applied voltage.

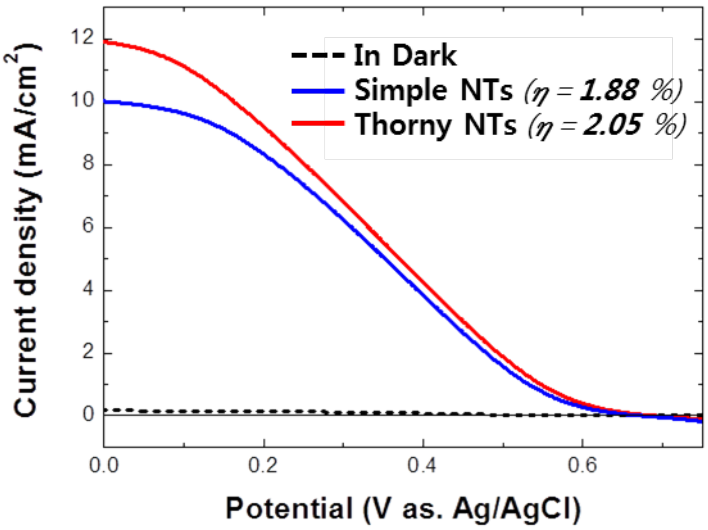


Figure S3. I-V characteristics of PEC solar cell using a photoanoecomparised of simple nanotubes (Simple NTs) and hierarchical thorny nanotubes (Thorny NTs) of CdSe.