Large scale fabrication of well-aligned CdS/p-Si shell/core nanowire arrays for photo detectors using solution methods

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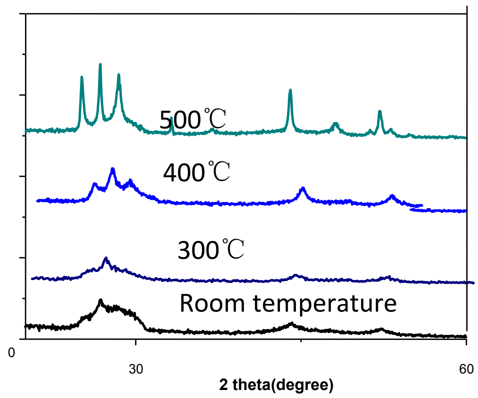
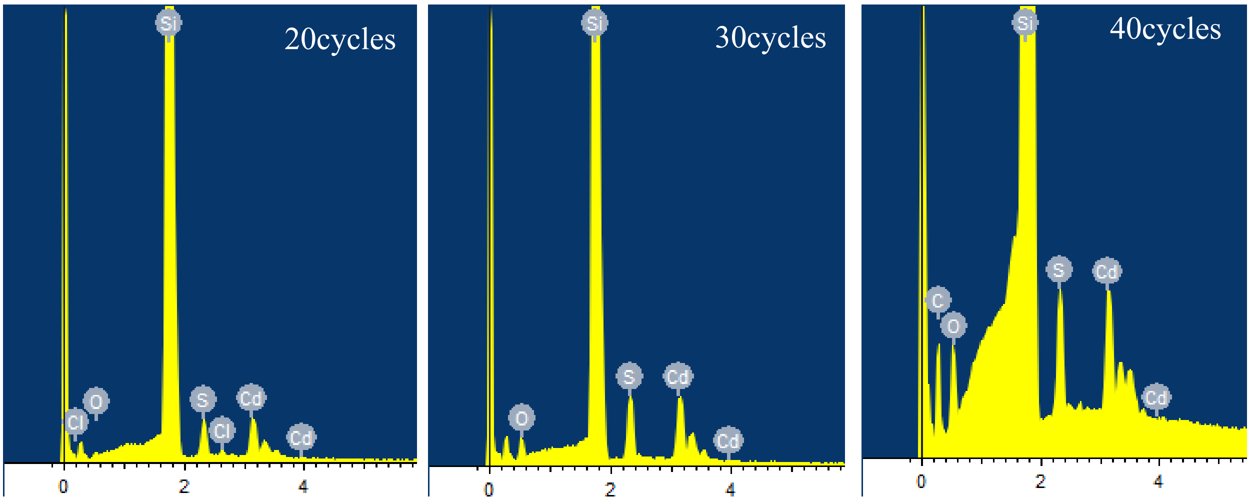


Fig.S1 The XRD pattens of different annealing temperature

The gadual increase of the Cd and S atoms on the CdS/SiNWA is shown in Fig.S1. The molar ratio of Cd to S is also increasing from (0.72 to 0.78), this indicates that the vacancy of S is increasing.



Element	Wt%	At%
C K	11.97	24.16
O K	2.39	3.62
Si K	82.54	71.25
S K	0.57	0.43
Cd L	2.53	0.55
Molar ratio of Cd to S		0.78

Element	Wt%	At%
O K	1.70	3.13
Si K	89.03	93.20
S K	1.47	1.41
Cl K	0.50	0.36
Cd L	7.29	1.91
Molar ratio of Cd to S		0.74

Element	Wt%	At%
O K	6.02	11.07
Si K	79.97	83.70
S K	2.40	2.20
Cd L	11.60	3.03
Molar ratio of Cd to S		0.72

Fig.S2 The EDS spectra of CdS/SiNWA for different number of SILAR cycles

The reflectance spectra are shown in Fig.S3 measured by UV-vis-IR spectrophotometer fitted with an integrating sphere, the spectra are labeled by the number of SILAR cycles. Since the thickness of Silicon substrate is about 300um in addition to the 10um nanowires, it is a little transmission, so the absorption can be calculated by Absorption=100-Reflectancy. We can get the CdS optical band is at about 510nm.

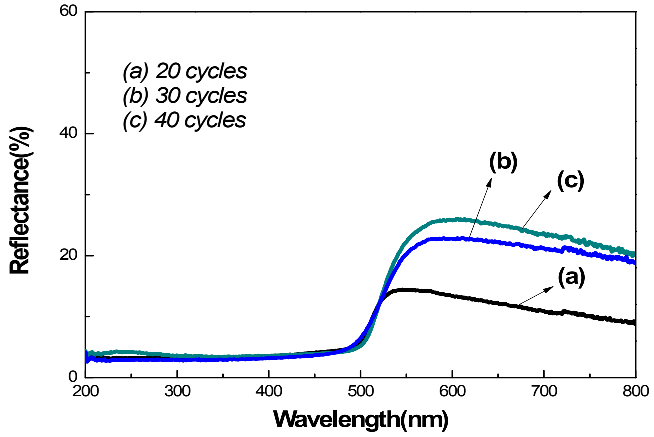


Fig.S3 The reflectance of CdS/SiNWA for different number of SILAR cycles

Fig.S4 shows a typical I-V curve of the CdS/Cu, this is to explain that the interfaces of the CdS/Cu have no rectifying effect.

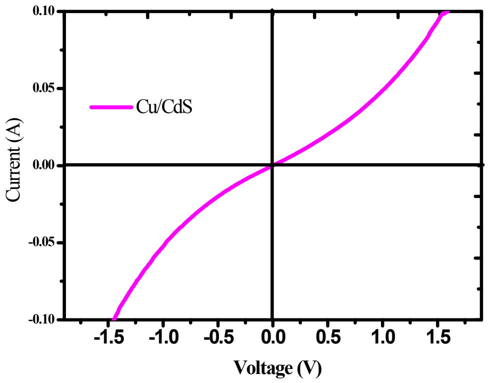


Fig.S4 I-V characteristics of CdS/Cu and Si/Al

(1) n-contact on the CdS

Two n-contact pats with 2mm diameter were formed on the n-CdS by evaporating Cu(100nm)/Au(10nm) through a shadow mask. I-V characteristic was measured by probing these two Cu/Au n-contacts.

(2) p-contacts on p-Si NWs

p-contact circle pats with 2mm diameter were formed on the Si NWs on p-Si substrate by evaporating Cu(10nm) through a shadow mask. I-V characteristics were measured by probing the Cu circle pats as schematically shown in Fig.S5(a), from which the I-V characteristics were obtained, shown in Fig.S5(b). The present CdS/SiNWs core-shell heterojunction offers the beneficial effect on rectifying characteristics, that is, effective suppression of recombination activity and enhanced rectifying effect indicates that CdS shell serves as a natural barrier and protects the device from unwanted electricity leakage.

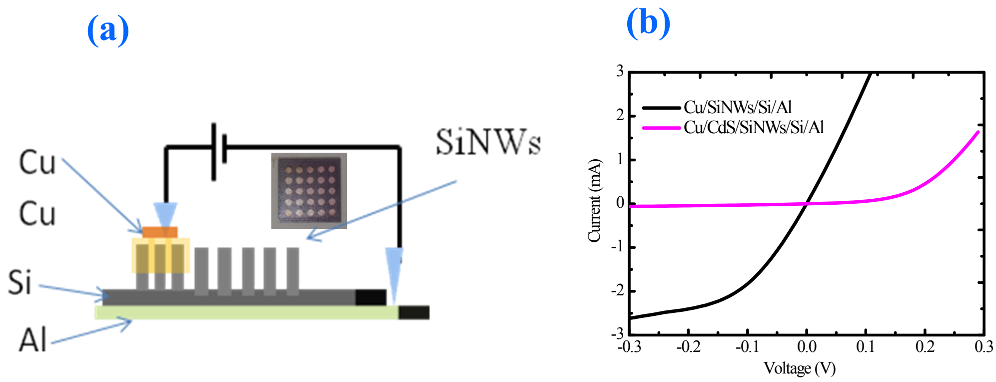


Fig.S5 (a) Schematic of the structure to measure the I-V across p-Si. The inset is photo of Al circle pats on Si NWs; (b) I-V characteristics of Cu/SiNWs/Si/Al and Cu/CdS/SiNWs/Si/Al

The frequency range chosen for the measurement was from 1Hz to 10^6Hz with an ac amplitude of 10mV. It can be seen from the figure that the expected single semicircle occurs, which indicates that this device possess diode characteristics. We have conducted performance fitting and simulation of this data for an equivalent circuit shown in the inset. The analysis indicates that contact resistance is about 46.7Ω, it is a fact that the contacts of Cu/CdS and Si/Al are not good ohmic contact, but it can be seen from the Fig.S3 that the I-V curves have no obvious asymmetry, it further clarify that the diode characteristics come from the interface of the CdS/Si.

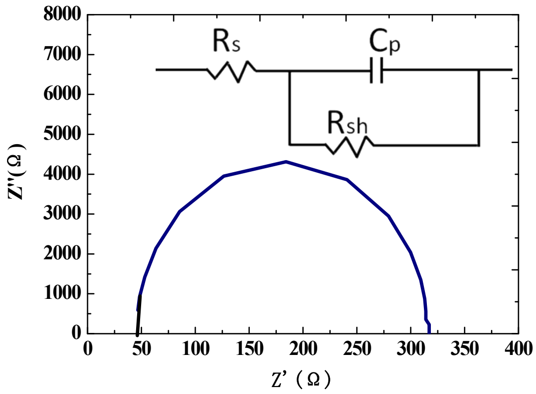


Fig S6. IS measurements(Nyquist plot) of CdS/Si NWs junctions in the dark. Inset shows the equivalent circuit for the same.