Supporting Information

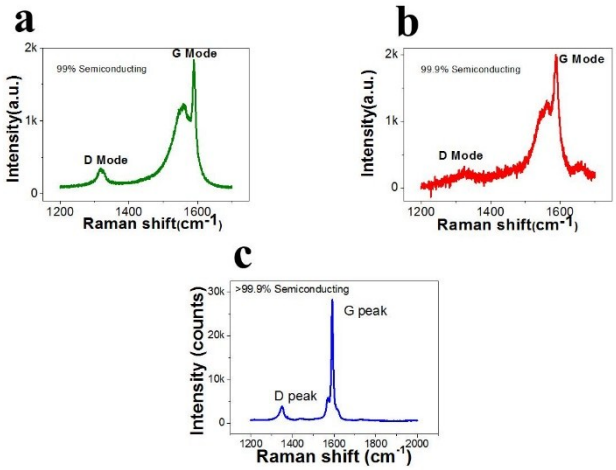

Figure S1. a) b) and c) Raman spectra showing G-band and D-band peaks of carbon nanotube thin films with different purity s-CNTs.

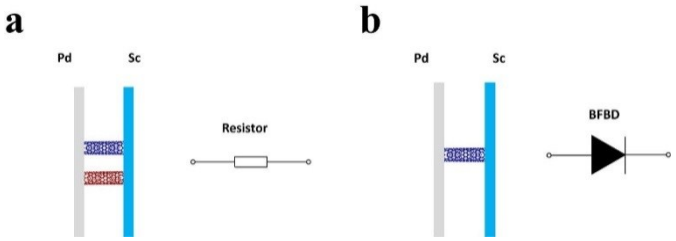

Figure S2. Direct transportation dominated condition. Short-channel condition for low purity a) and high purity b) S-CNTs based devices and corresponding equivalent circuit. The red and blue carbon nanotube represent the metallic carbon nanotube and semiconducting carbon nanotube separately.

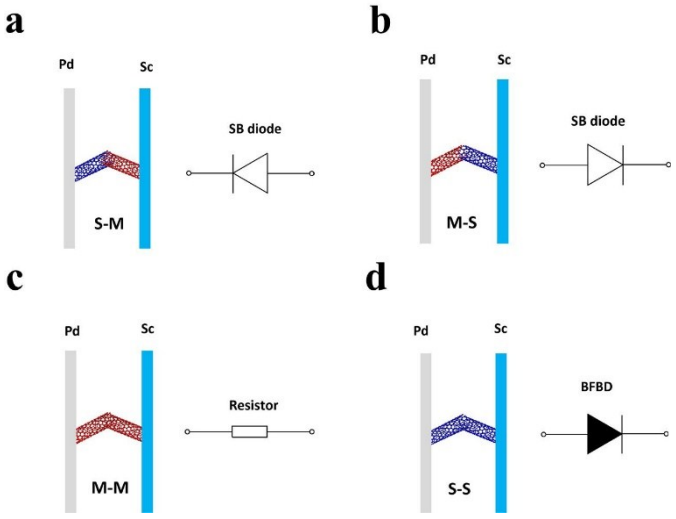

Figure S3. One junction dominated transportation condition. a) s-m junction. b) m-s junction. c) m-m condition. d) s-s condition and corresponding equivalent circuit. The red and blue carbon nanotube represent the metallic carbon nanotube and semiconducting carbon nanotube separately.

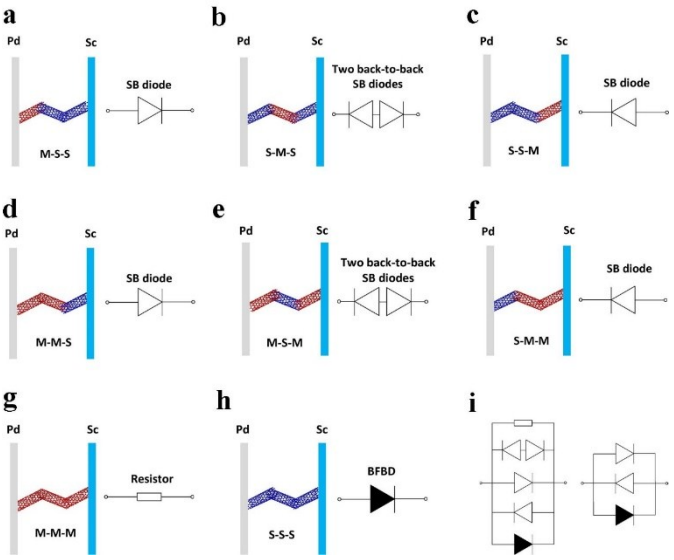

Figure S4. Two junctions dominated transportation condition and corresponding equivalent circuit. a) m-s-s connection. b) s-m-s connection. c) s-s-m connection. d) m-m-s connection. e) m-s-m connection. f) s-m-m connection. g) m-m-m connection. h) s-s-s connection. i) Left: Equivalent circuits for long-channel condition. Right: Simplified equivalent circuits for long-channel condition. The red and blue carbon nanotube represent the metallic and semiconducting carbon nanotube separately.

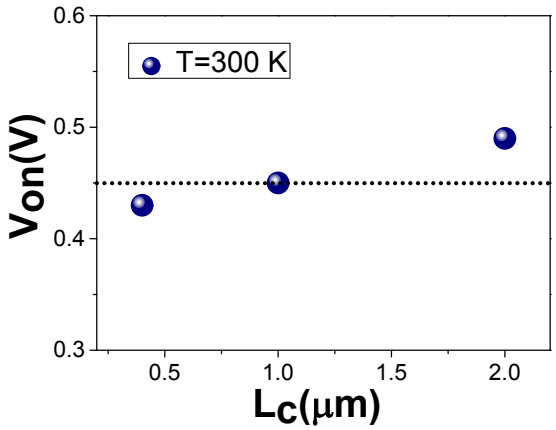

Figure S5. Turn-on voltage of diodes using >99.9% purity S-CNTs.

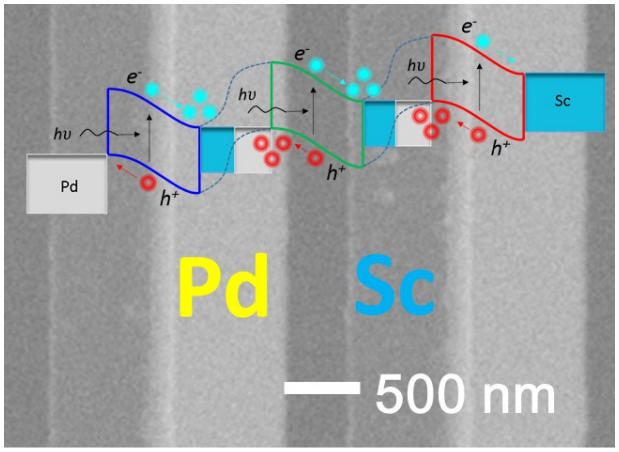

Figure S6. SEM image of the sub-wavelength cascading diode. Inset is the corresponding band diagram of the cascading diode with n=3.

	Photovoltage (V)	Wavelength @ Power density	Speed (ms)	Size (μm)
Ref 35	0.1	NIR@80 mW/cm^2	~10 s	16000
Ref 36	~0.01	660nm @ 10 mW	~0.08 ms	4000×1500
Ref 37	~0.4	1000-1365 nm @ 137 mW/cm^2	NA	NA
Ref 38	~0.25	1000-1365 nm @ 17 mW/cm^2	NA	NA
Ref 39	0.0003	2.52 THz @ 0.12 mW	NA	1000
Ref 40	0.5-0.54	AM1.5@100 mW/cm^2	NA	NA
Ref 41	0.00016	660nm @ 7 mW	NA	NA
Ref 42	0.7	AM1.5@100 mW/cm^2	NA	NA
Our device	4.35	1800nm @ 5.78 W/cm^2	18 ms	0.4

Table S1. Photovoltage comparison between reported values of CNT based optoelectronic devices and our cascading device.