

Figure S1. Size distribution of (a) Pencil tip diameter, (b) Pencil tip length, (c) Pencil holder diameter, and (d) Pencil holder length of ZnO NP superstructure

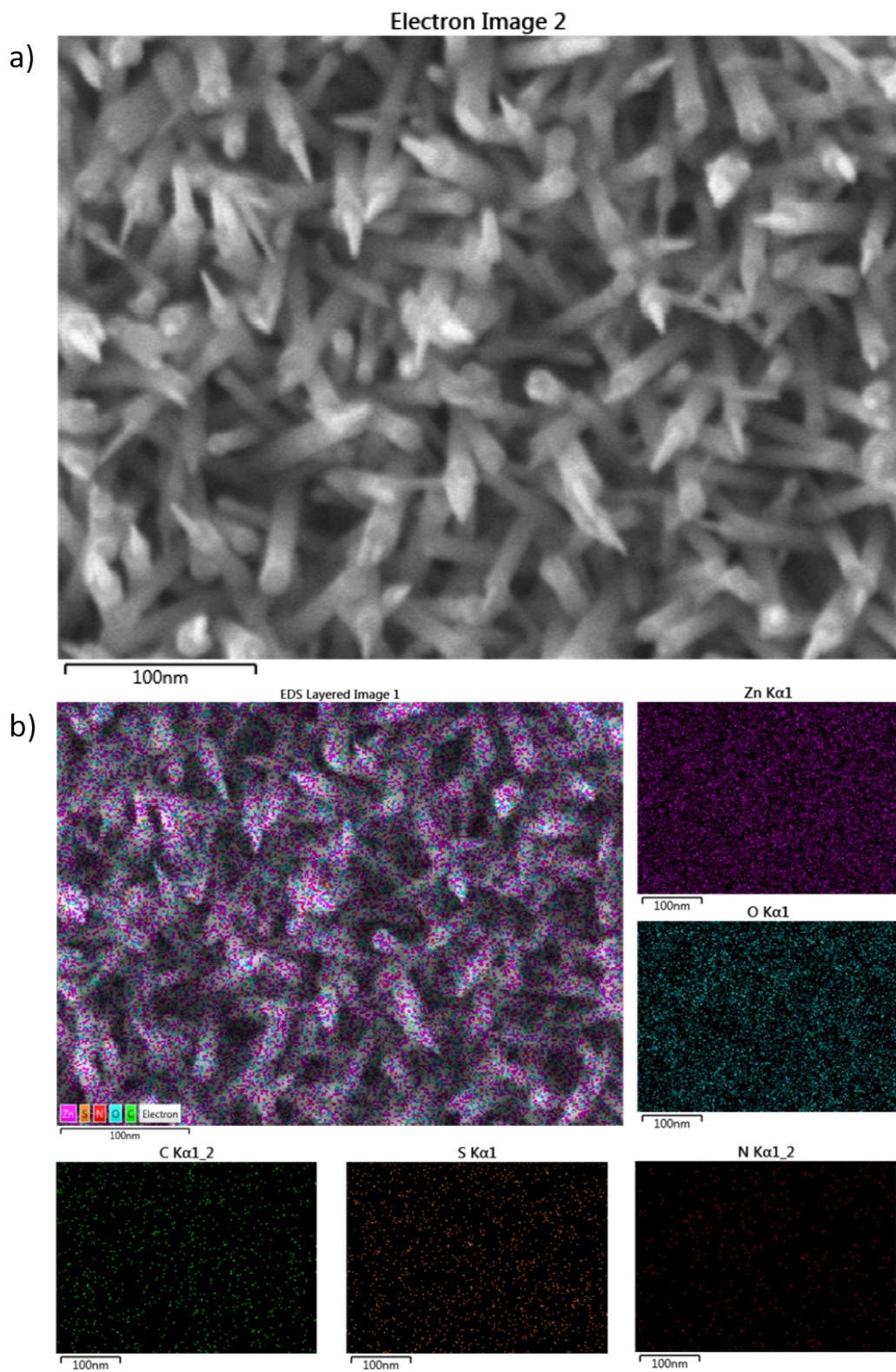


Figure S2. (a) Clean SEM Image and (b) EDS mapping of ZnO NPC/S,N-GQDs composite.

Table S1. Atomic percentage of each ZnO NPC/S,N-GQDs components

Element	Atomic %	Standard Label
C	23.24	C vit.
N	2.63	BN
O	41.09	SiO <sub>2</sub>
S	3.37	FeS <sub>2</sub>
Zn	29.67	Zn

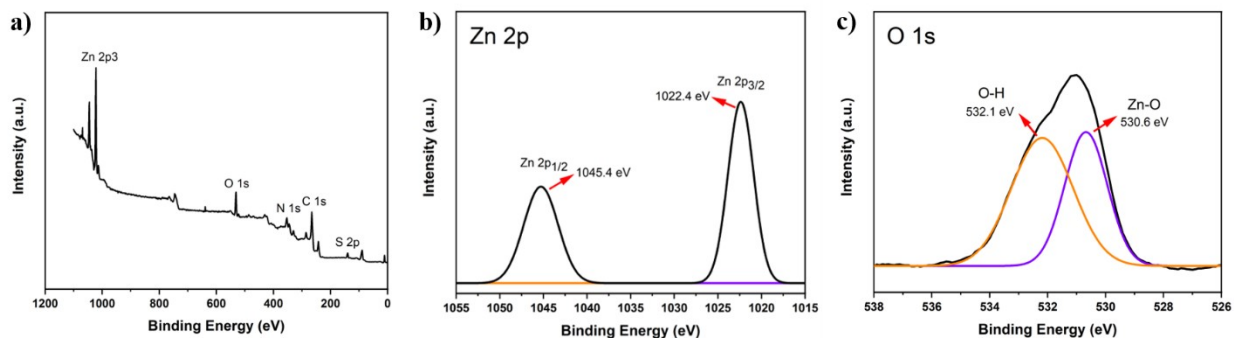


Figure S3. (a) Survey XPS spectra of ZnO NPC/S,N-GQDs, High resolution XPS spectra of (b) Zn 2p, and (c) O 1s core elements.

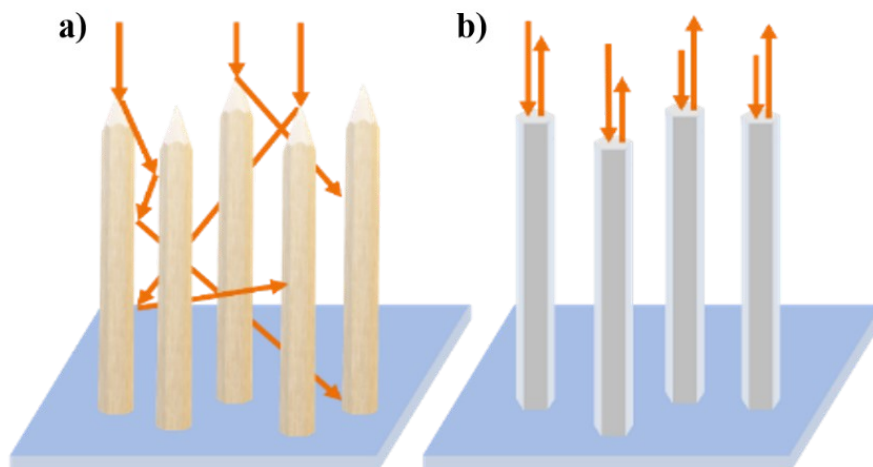


Figure S4. Illustration of light interaction with (a) ZnO NPC and (b) ZnO NR grown on FTO glass.

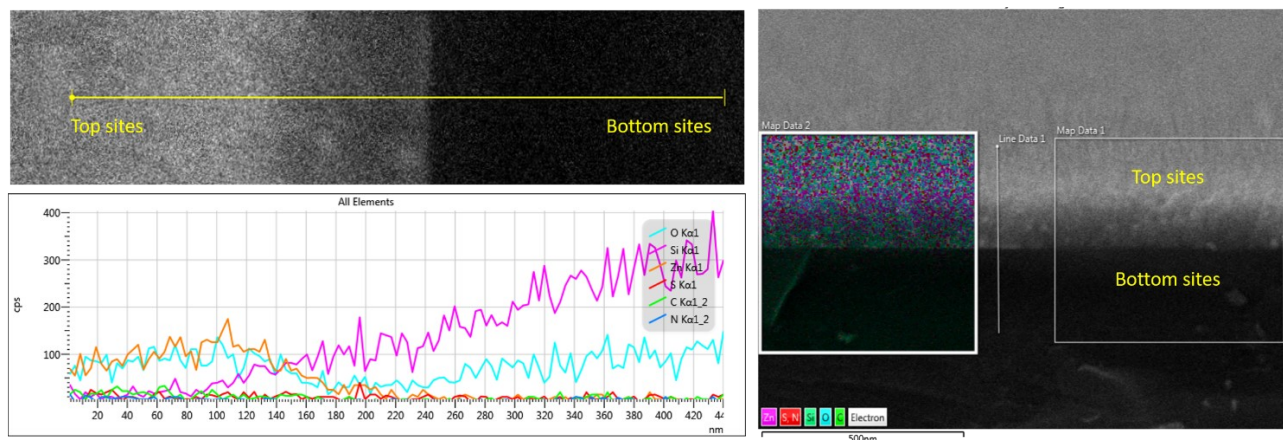


Figure S5. EDS element mapping of ZnO NPCs/S,N-GQDs in Cross-Section Position.

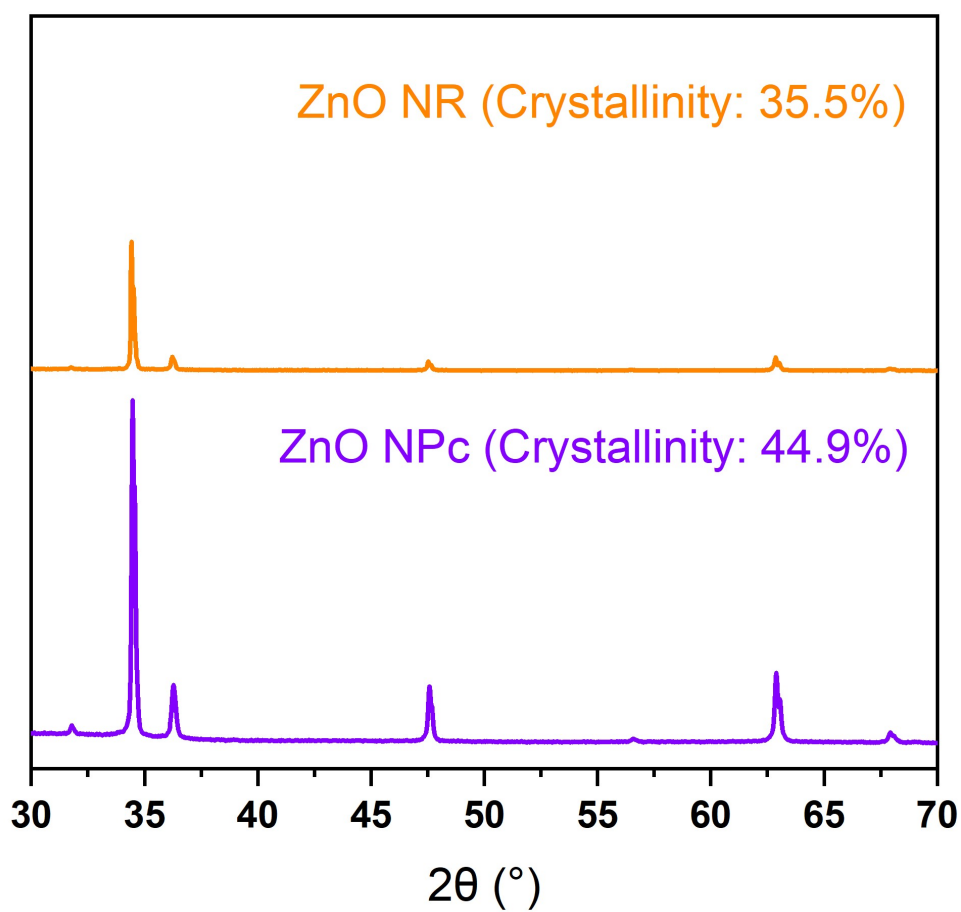


Figure S6. XRD Pattern and Its Crystallinity of ZnO NR and ZnO NPc.