

Supplementary Information

Selective enhancement of red emission from upconversion nanoparticles *via* surface plasmon-coupled emission

Ai Ling Feng,^{abc} Min Lin,^{*acd} Limei Tian,^e Hong Yuan Zhu,^{ac} Hui Guo,^{ac} Srikanth Singamaneni,^e Zhenfeng Duan,^d Tian Jian Lu^c and Feng Xu^{*ac}

^a The MOE Key Laboratory of Biomedical Information Engineering, School of Life Science and Technology, Xi'an Jiaotong University, Xi'an 710049, P.R. China. E-mail: fengxu@mail.xjtu.edu.cn, minlin@mail.xjtu.edu.cn

^b Institute of Physics & Optoelectronics Technology, Baoji University of Arts and Sciences, Baoji 721016, China

^c Bioinspired Engineering and Biomechanics Center (BEBC), Xi'an Jiaotong University, Xi'an 710049, P.R. China

^d Center for Sarcoma and Connective Tissue Oncology, Massachusetts General Hospital, Harvard Medical School, MA 02114, USA

^e Department of Mechanical Engineering and Materials Science, Institute of Materials Science and Engineering, Washington University in St. Louis, St Louis, MO 63130, USA

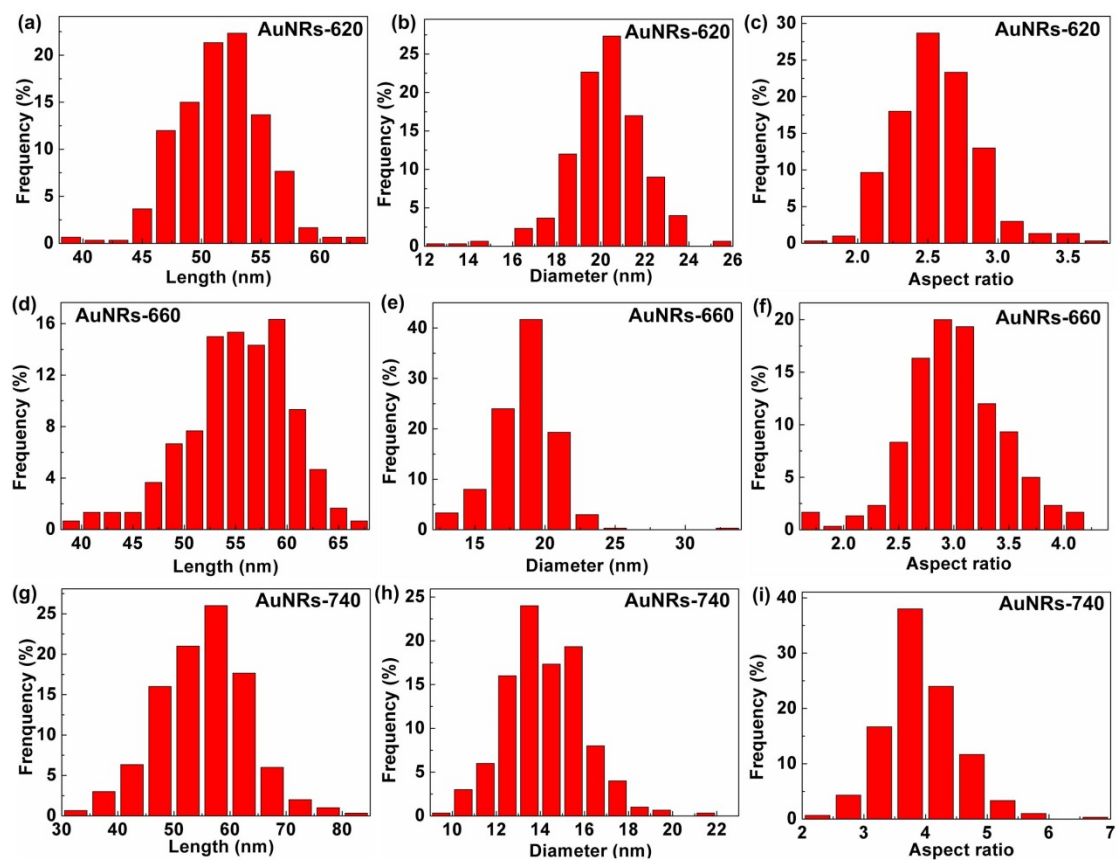


Fig. S1 Statistical analysis of size distribution including length, diameter and aspect ratios of the AuNRs. a-c) AuNRs-620; d-f) AuNRs-660 and g-i) AuNRs-740.

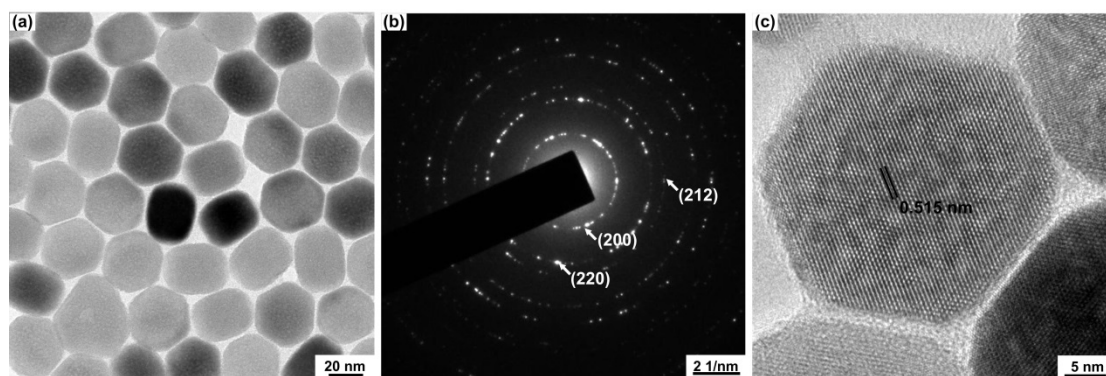


Fig. S2 Characterization of UCNPs. a) Representative TEM image. b) Diffraction pattern. c) HRTEM.

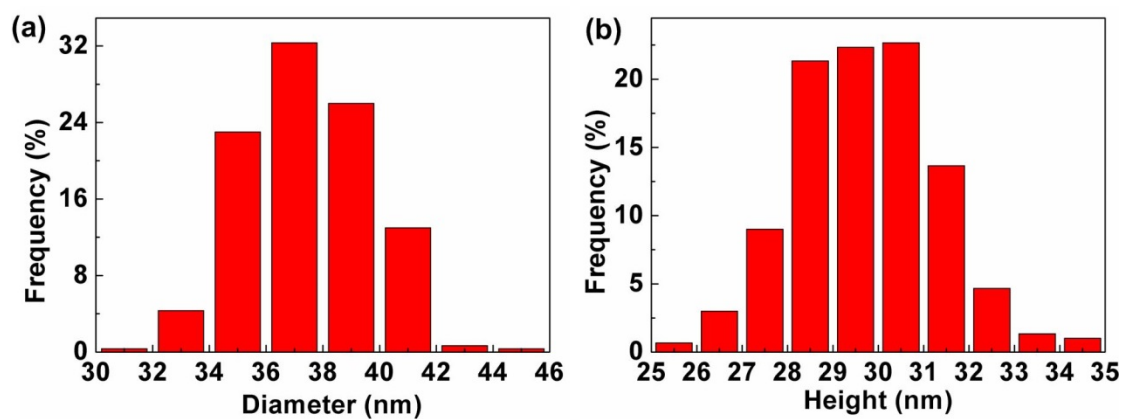


Fig. S3 Statistical analysis of size distribution. a) Diameter and b) Height of six prism-shaped UCNPs-PAA.

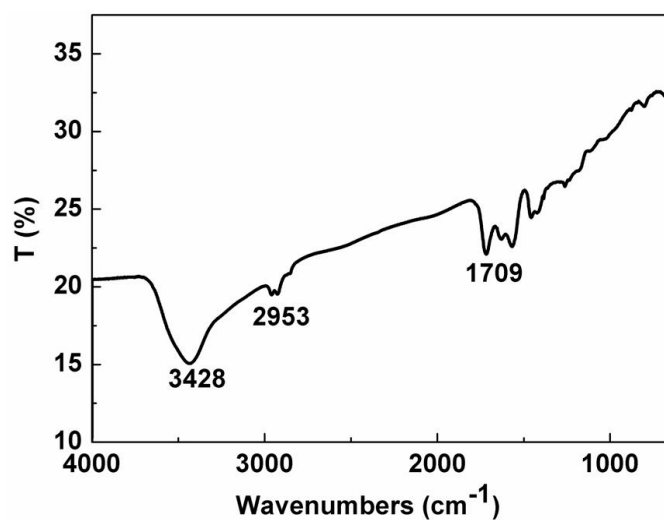


Fig. S4 FT-IR spectrum of UCNPs-PAA, indicating the existence of -COOH group.

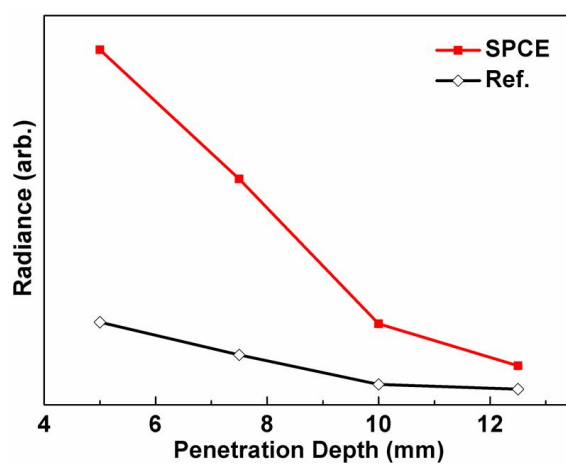


Fig. S5 Quantitative analysis of the relationship between the radiance and penetration depth for the samples of the UCNPs in combination with plasmon nanostructures of AuNRs-660 spaced by 8 nm polyelectrolyte multilayers and only UCNPs as reference (Ref.) collected at red emission of 650 nm.

Table S1 Statistical analysis of size distribution for AuNRs.

Parameters	AuNRs-620			AuNRs-660			AuNRs-740		
	Length (nm)	Diamete r (nm)	Aspect Ratio	Length (nm)	Diamete r (nm)	Aspect Ratio	Length (nm)	Diamete r (nm)	Aspect Ratio
Mean	51.6	20.3	2.6	55.2	18.6	3.0	55.2	14.2	3.9
Max	62.4	25.5	3.7	67.5	32.3	4.2	83.5	22.0	6.5
Min	38.6	12.5	1.8	38.9	13.2	1.7	32.3	9.8	2.2
SD	3.6	1.7	0.3	5.1	2.2	0.4	8.2	1.8	0.6

Table S2 Statistical analysis of size distribution for UCNPs-PAA.

	Diameter (nm)	Height (nm)
Mean	37.5	29.7
Max	45.8	38.6
Min	30.4	25.5
SD	2.2	1.7

Table S3 LSPR wavelength of AuNRs on different conditions.

Nomenclatur e	LSPR wavelength in solution (nm)	LSPR wavelength on silicon (nm)	Blue-shift (nm)
AuNRs-620	670	620	50
AuNRs-660	725	660	65
AuNRs-740	810	740	70