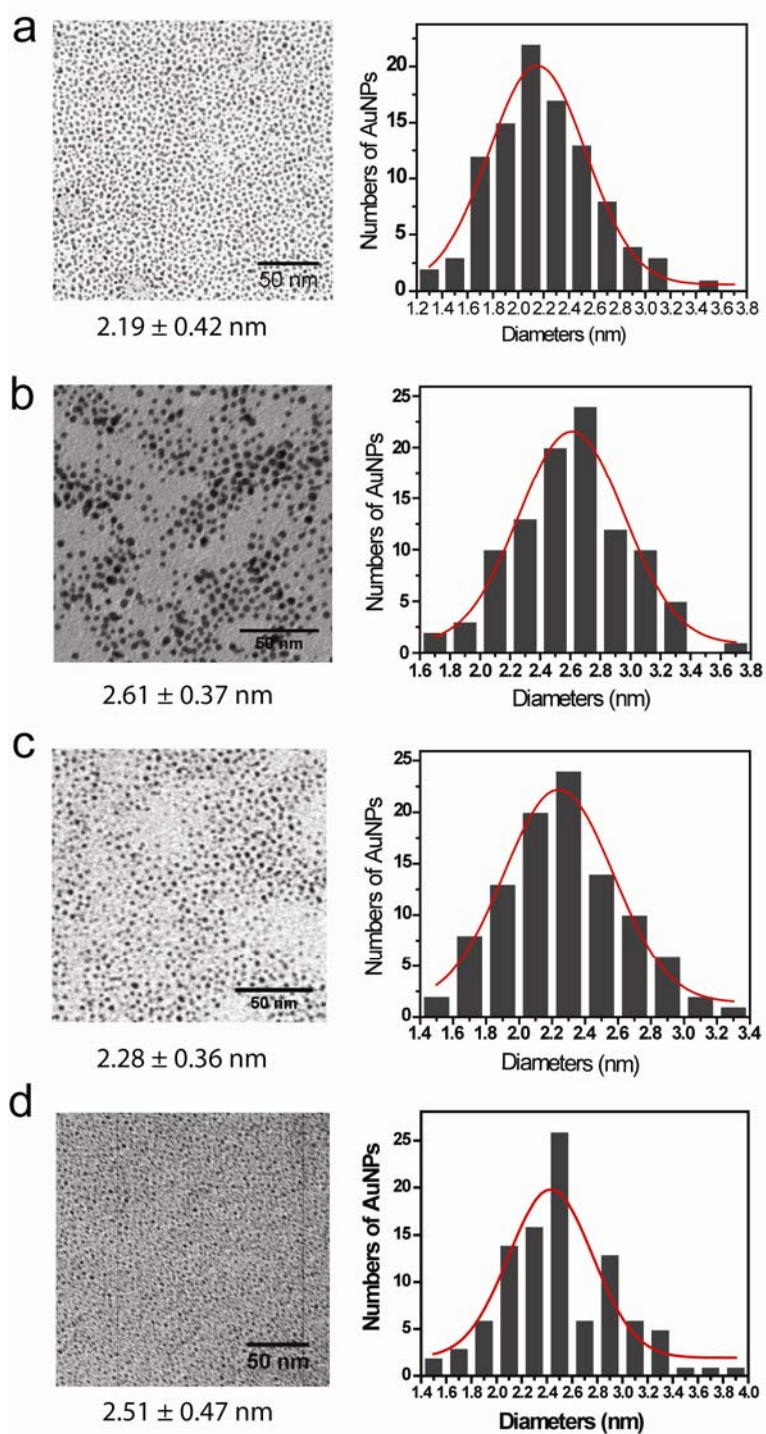


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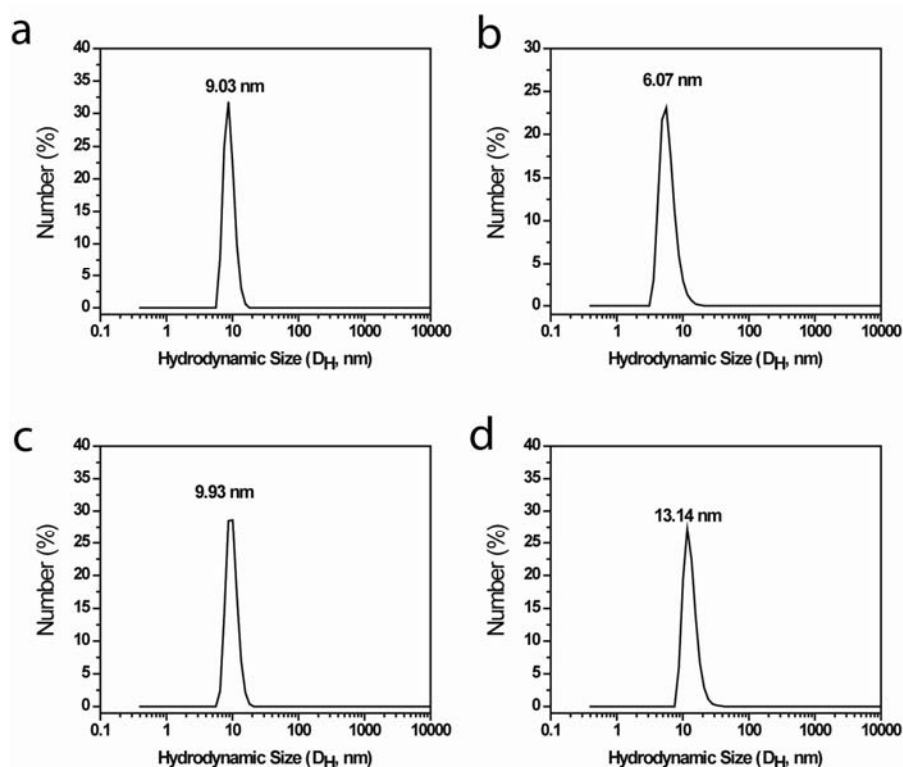
**Surface properties dictate uptake, distribution, excretion, and toxicity of nanoparticles in fish**

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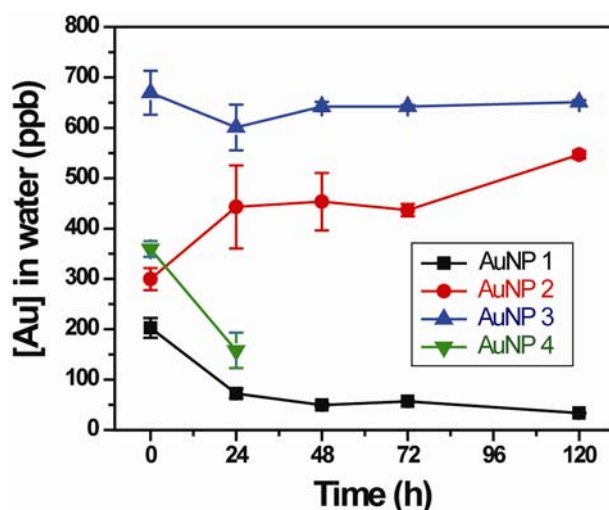
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**Figure S1. TEM images and size distributions of AuNPs. a, AuNP 1; b, AuNP 2; c, AuNP 3; d, AuNP 4.** The size distributions are shown in the right panels as histograms and fitted Gaussian curves (red line). In each histogram, 100 nanoparticles were randomly measured.



**Figure S2. Hydrodynamic sizes of AuNPs in conditioned water.** a, AuNP 1; b, AuNP 2; c, AuNP 3; d, AuNP 4.



**Figure S3. Au concentration in tank water during the course of the exposure experiments.** A single dose of 20 nM AuNPs was added to the water tank 30-60 minutes before adding the fish. During this 30-60 minute period, the water was aerated via an air-stone. During the aeration period, some of the AuNPs stick to the surface of the fish tanks, causing a drop in the total Au concentration. The time when the fish are added to the tank was set as 0 h. Aliquots (5 mL) of water were taken at 0, 24, 48, 72, and 120 h and analyzed by ICP-MS. Means in the figure are obtained from 3-6 measurements, and the errors bars represent the standard error of the mean.

**Table S1. Biodistribution of AuNPs 1-3 in fish organs at 24 hr.**

Organs	Control <sup>#</sup>	AuNP 1 <sup>#</sup>	p <sup>&amp;</sup>	AuNP 2 <sup>#</sup>	p <sup>&amp;</sup>	AuNP 3 <sup>#</sup>	p <sup>&amp;</sup>
	Au (ng/mg)	Au (ng/mg)		Au (ng/mg)		Au (ng/mg)	
Brain	0.35 ± 0.14	1.10 ± 0.49	0.162	0.27 ± 0.08	0.609	0.20 ± 0.04	0.186
Heart	2.28 ± 1.11	19.0 ± 9.59	0.106	5.03 ± 3.68	0.485	1.57 ± 0.77	0.610
liver	0.19 ± 0.09	1.12 ± 0.57	0.126	0.22 ± 0.09	0.777	0.18 ± 0.04	0.924
Gonad	0.13 ± 0.05	12.1 ± 11.1	0.298	0.18 ± 0.08	0.573	0.09 ± 0.03	0.469
Dorsal fin	1.35 ± 0.76	1.03 ± 0.19	0.684	3.41 ± 2.69	0.472	0.76 ± 0.32	0.485
Gill	0.24 ± 0.09	5.07 ± 1.38	0.004	0.53 ± 0.11	0.054	0.16 ± 0.03	0.423
Intestine	0.12 ± 0.05	35.2 ± 9.10	0.002	8.15 ± 3.19	0.025	7.35 ± 3.68	0.070

<sup>#</sup> The concentration unit refers to ng of Au per mg of organ weight; means are averaged from eight fish (n=8), and the errors are reported as the standard error of the mean. <sup>&</sup> p-value of one-way ANOVA between control and AuNP treated groups.

**Table S2. Biodistribution of AuNPs 1-3 in fish organs at 72 hr.**

Organs	Control <sup>#</sup>	AuNP 1 <sup>#</sup>	p <sup>&amp;</sup>	AuNP 2 <sup>#</sup>	p <sup>&amp;</sup>	AuNP 3 <sup>#</sup>	p <sup>&amp;</sup>
	Au (ng/mg)	Au (ng/mg)		Au (ng/mg)		Au (ng/mg)	
Brain	0.47 ± 0.16	0.72 ± 0.26	0.240	0.54 ± 0.16	0.399	0.22 ± 0.08	0.409
Heart	5.45 ± 2.72	14.66 ± 7.27	0.115	3.41 ± 1.27	0.512	1.43 ± 0.41	0.484
liver	0.46 ± 0.18	0.74 ± 0.27	0.074	0.23 ± 0.08	0.736	0.17 ± 0.07	0.866
Gonad	0.30 ± 0.15	1.45 ± 0.55	0.032	0.51 ± 0.27	0.195	0.54 ± 0.31	0.207
Dorsal fin	1.38 ± 0.69	5.21 ± 2.06	0.100	1.35 ± 0.51	0.999	0.62 ± 0.17	0.364
Gill	0.25 ± 0.12	2.17 ± 0.42	0.0005	0.63 ± 0.08	0.005	0.33 ± 0.09	0.437
Intestine	0.08 ± 0.02	144 ± 25.6	0.00006	11.19 ± 2.75	0.0013	40.85 ± 13.71	0.010

<sup>#</sup> The concentration unit refers to ng of Au per mg of organ weight; means are averaged from eight fish (n=8), and the errors are reported as the standard error of the mean. <sup>&</sup> p-value of one-way ANOVA between control and AuNP treated groups.

**Table S3. Biodistribution of AuNPs 1-3 in fish organs at 120 hr.**

Organs	Control <sup>#</sup>	AuNP 1 <sup>#</sup>	p <sup>&amp;</sup>	AuNP 2 <sup>#</sup>	p <sup>&amp;</sup>	AuNP 3 <sup>#</sup>	p <sup>&amp;</sup>
	Au (ng/mg)	Au (ng/mg)		Au (ng/mg)		Au (ng/mg)	
Brain	0.15 ± 0.06	0.34 ± 0.07	0.091	0.09 ± 0.01	0.364	0.04 ± 0.02	0.138
Heart	0.77 ± 0.32	3.63 ± 2.83	0.355	0.41 ± 0.10	0.324	1.03 ± 0.35	0.618
liver	0.05 ± 0.03	0.32 ± 0.20	0.226	0.11 ± 0.04	0.308	0.15 ± 0.05	0.168
Gonad	0.08 ± 0.06	0.09 ± 0.03	0.889	0.08 ± 0.03	0.910	0.23 ± 0.11	0.260
Dorsal fin	0.27 ± 0.14	2.18 ± 1.15	0.151	1.11 ± 0.50	0.154	0.47 ± 0.29	0.566
Gill	0.10 ± 0.04	1.09 ± 0.08	0.00003	0.48 ± 0.09	0.008	0.24 ± 0.03	0.021
Intestine	0.03 ± 0.01	75.4 ± 21.6	0.013	9.95 ± 3.00	0.017	13.3 ± 7.29	0.118

<sup>#</sup> The concentration unit refers to ng of Au per mg of organ weight; means are averaged from eight fish (n=8), and the errors are reported as the standard error of the mean. <sup>&</sup> p-value of one-way ANOVA between control and AuNP treated groups.

**Table S4. Biodistribution of AuNP 4 in fish organs.**

Organs	AuNP 4 <sup>#</sup>	
	Au (ng/mg)	p <sup>&amp;</sup>
Brain	1.29 ± 0.15	0.0004
Heart	15.95 ± 5.27	0.024
liver	0.99 ± 0.23	0.006
Gonad	6.05 ± 3.97	0.159
Dorsal fin	14.30 ± 3.44	0.002
Gill	25.45 ± 5.71	0.0004
Intestine	0.86 ± 0.29	0.026

“#” and “&” are the same as in Tables S1, S2, and S3. All of the fish died in 24 hrs after exposure to AuNP 4.