

Supplementary Information

A circular non-uniform electric field gel electrophoresis for separation and concentration of nanoparticles

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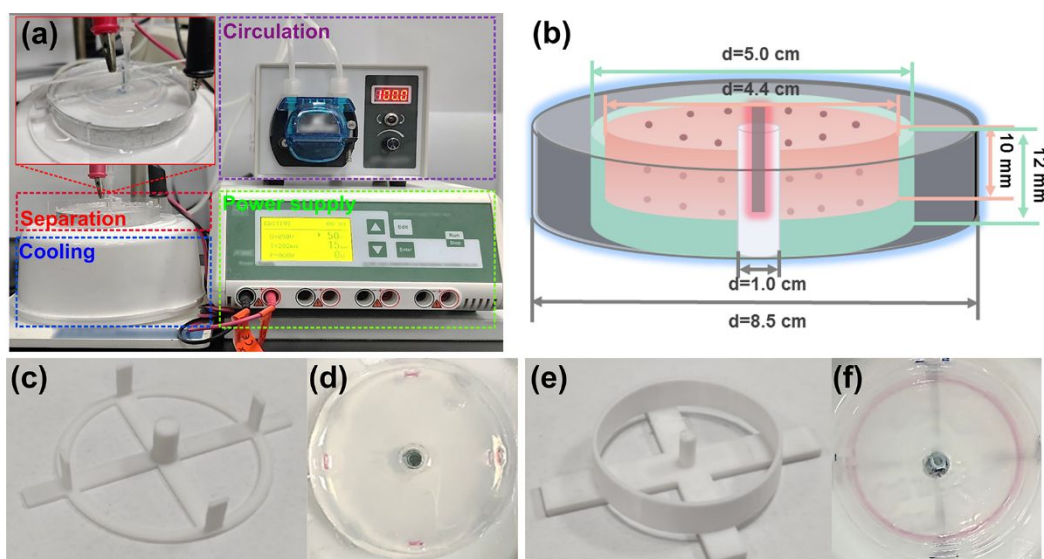


Figure S1. (a) The whole device including separation system, cooling system, circulation system and power supply system. (b) Scheme of separation system. Sample loading moulds of hole-type (c, d) and ring-type (e, f).

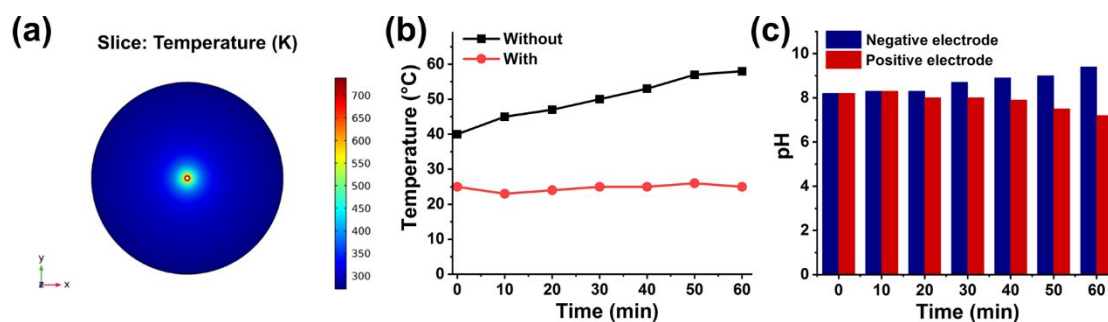


Figure S2. (a) COMSOL simulation for the heating effect of the circular non-uniform electric field. (b) Temperature in center without or with the circulation and cooling system. (c) pH near negative and positive electrodes under the assist of the circulation and cooling system.

Before the separation experiments, the temperature and pH of separation system are first considered under the circular non-uniform electric field. The highest heat in center gives rise to continuous increase of the temperature from 40 to 55 °C (Figure S2a, b). Besides, oxygen is generated at the anode and hydrogen is generated at the cathode during electrophoresis. The pH of the anode region decreases with the increase of hydrogen ions, and the pH of the cathode region increases with the increase of hydroxide ions at the same time (Figure S2c). Nevertheless, the temperature is stable nearby center at 25 °C with the aid of circulation and cooling system, and the pH values vary slightly in 30 min.

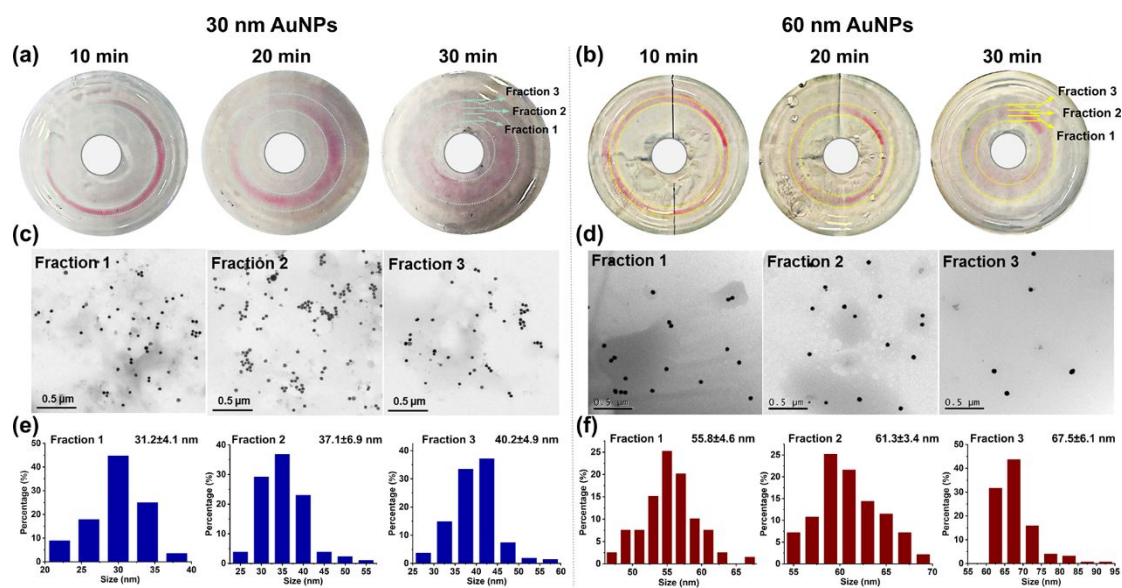


Figure S3. Analysis of 30 and 60 nm AuNPs electrophoresis bands obtained under the circular non-uniform electric field in horizontal: (a, b) migration images, (c, d) typical TEM images of AuNPs from different fractions, (e, f) size distributions of AuNPs from different fractions, calculated by TEM data.

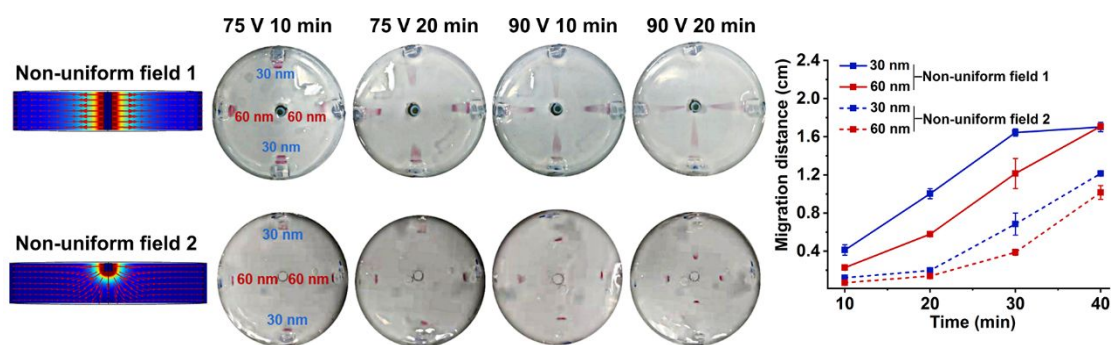


Figure S4. Electrophoresis migration and electrophoretic velocity analysis of 30 and 60 nm AuNPs under the circular non-uniform electric field 1 and 2.

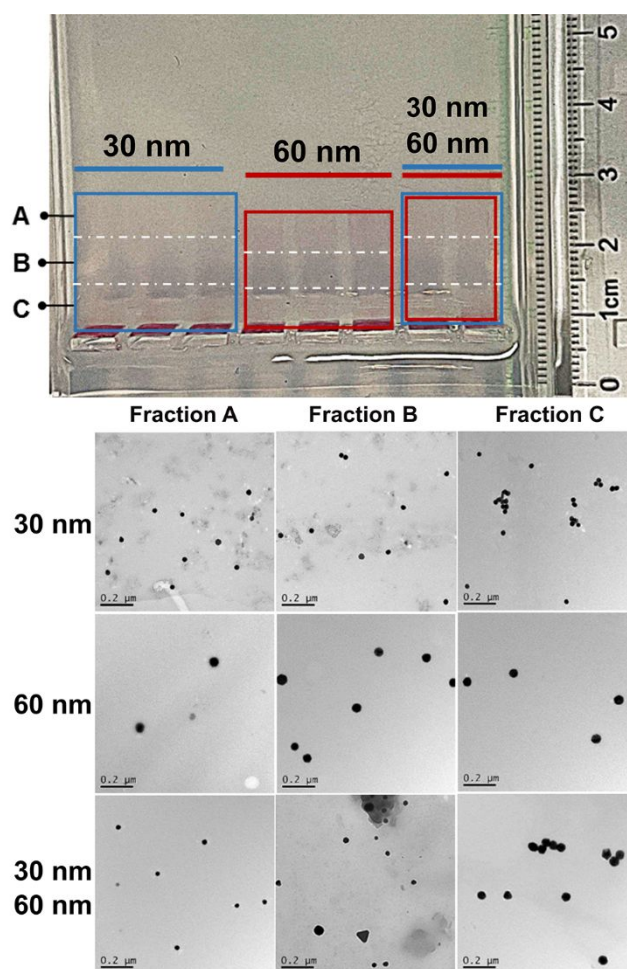
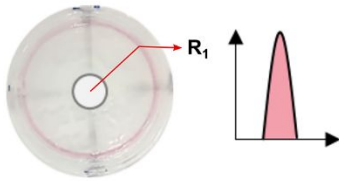
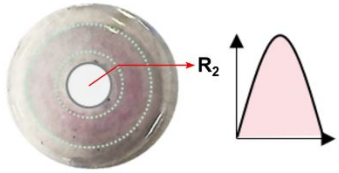


Figure S5. Electrophoresis migration and typical TEM images of 30 and 60 nm AuNPs after the slab gel electrophoresis.

Non-uniform field 1

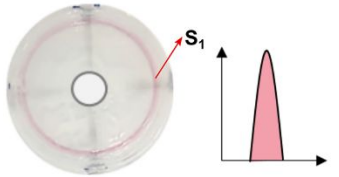


$$A = \frac{2\pi R_1}{2\pi R_2} = \frac{R_1}{R_2}$$



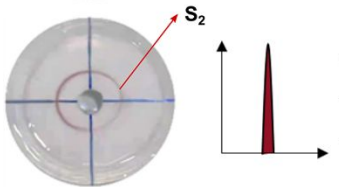
R_1 (mm)	R_2 (mm)	V_1 (mm ³)	V_2 (mm ³)	A
16.1	9.6	-	-	1.7

Non-uniform field 2



$$n_1 = n_2 \quad c_1 V_1 = c_2 V_2$$

$$A = \frac{c_2}{c_1} = \frac{V_1}{V_2}$$



S_1 (mm ²)	S_2 (mm ²)	H_1 (mm)	H_2 (mm)	V_1 (mm ³)	V_2 (mm ³)	A
189.5	47.9	10	2	1895.1	95.8	19.8

Figure S6. Calculation of concentration effect under the non-uniform electric field strategy.