

Supporting information

Yolk/shell colloidal crystals incorporating movable cores with their motion controlled by an external electric field

Kanako Watanabe,¹, Haruyuki Ishii,¹ Mikio Konno,¹ Arnout Imhof,² Alfons van Blaaderen²

and Daisuke Nagao^{1,*}

¹ Department of Chemical Engineering, Tohoku University,

6-6-07 Aoba, Aramaki-aza Aoba-ku, Sendai, 980-8579 (Japan)

² Soft Condensed Matter, Debye Institute for Nanomaterials Science,

Utrecht University Princetonplein 5, 3584 CC Utrecht (The Netherlands)

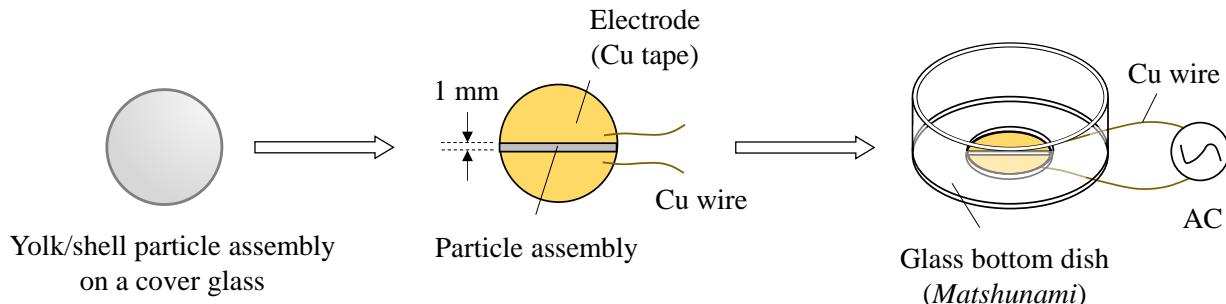


Figure S1. Schematic procedure of the application of an electric field to the yolk/shell particle assembly incorporating a silica core.

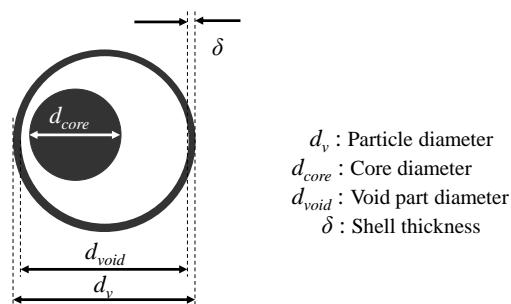


Figure S2. Definition of each symbols of yolk/shell particles.

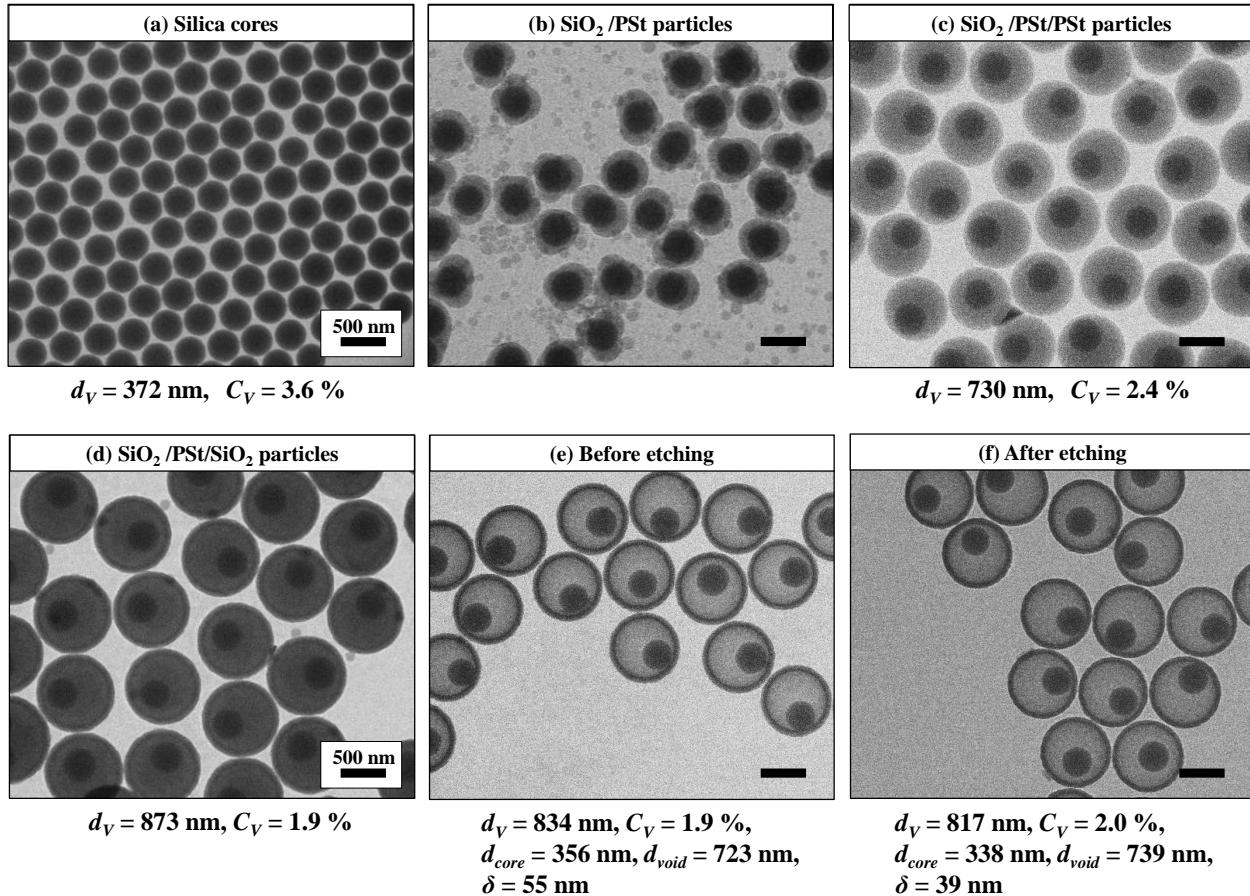


Figure S3. TEM images of particles formed in the synthesis yolk-shell particles incorporating a silica core.

(a) SiO_2 cores, (b) SiO_2/PSt particles, (c) $\text{SiO}_2/\text{PSt}/\text{PSt}$ particles, (d) Silica-coated core/shell particles, (e) Particles obtained by calcination of the particles (d), (f) Particles obtained by the slight etching of particles (e).

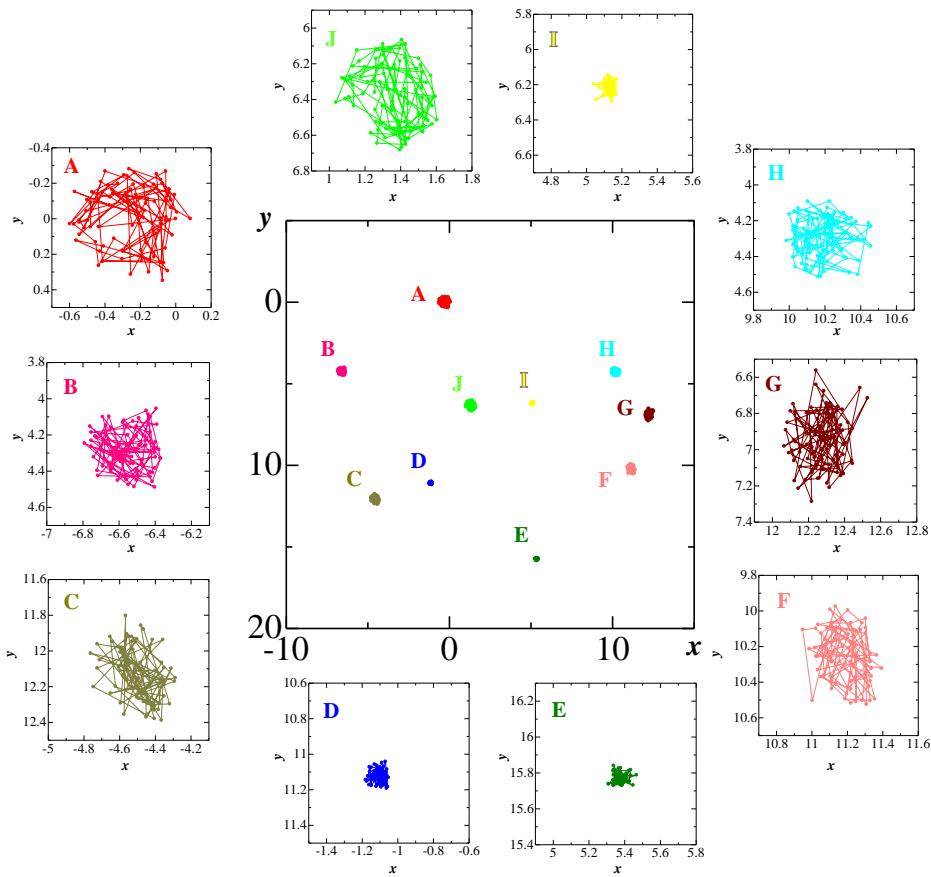
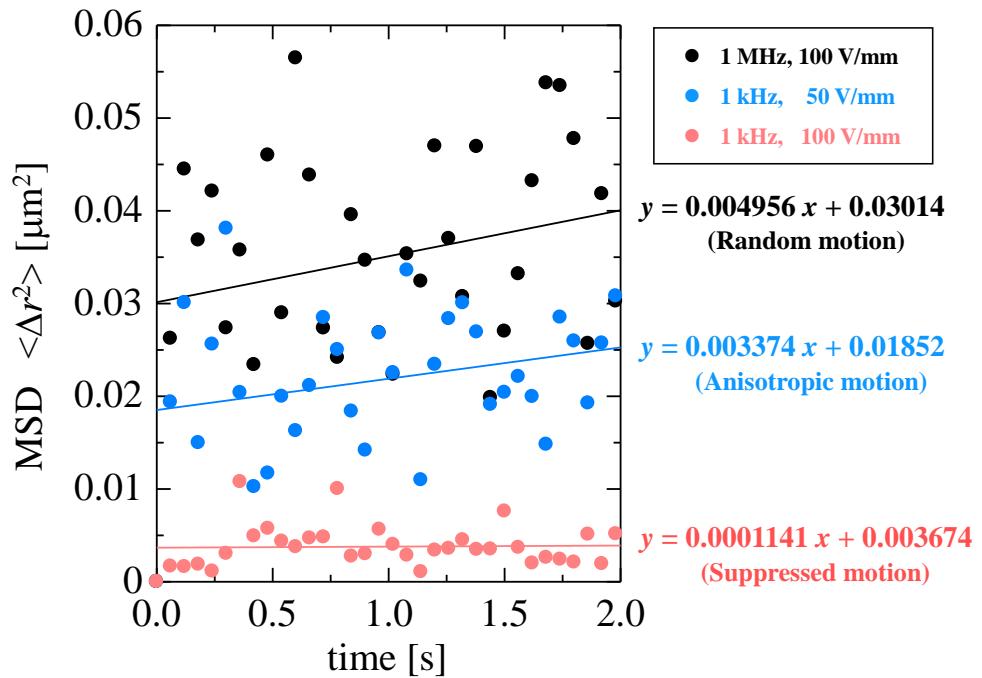


Figure S4. Representative example of traces of movable particles (A, B, C, F, G, H and J) and immobile particle (D, E and I) incorporated into silica shell shown in **Movie 6**.



$$\langle \Delta r^2(t) \rangle = \frac{1}{N} \sum_{n=1}^N (\Delta r(t)_n)^2 = \frac{1}{N} \sum_{n=1}^N (\Delta x(t)_n^2 + \Delta y(t)_n^2), \text{ (} N: \text{the number of movable cores) }$$

Figure S5. Mean square displacements travelled by a core under different applications of 1 MHz electric field at 100 V/mm and 1 kHz electric fields at 50 V/mm and 100 V/mm.

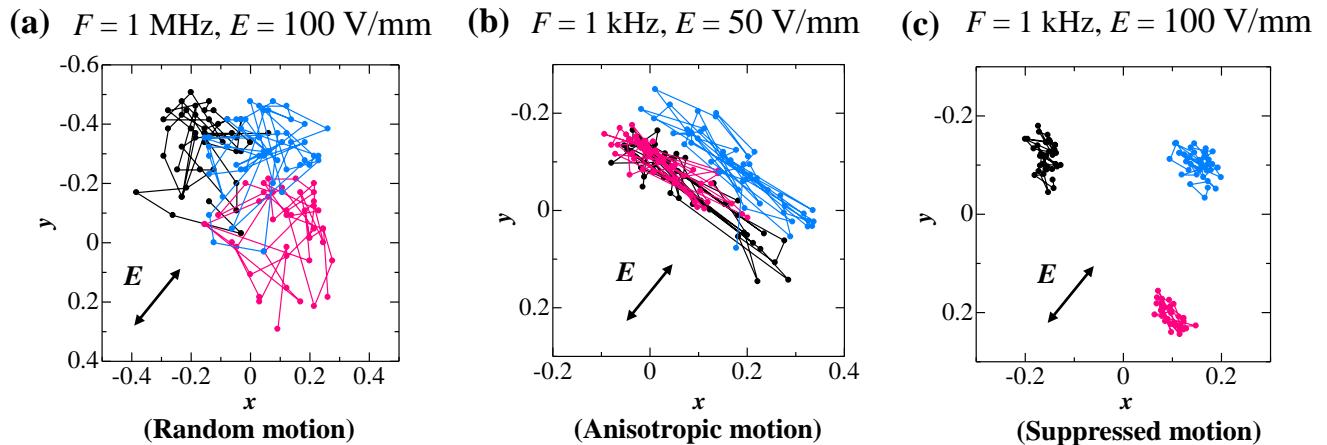


Figure S6. Traces of three movable silica particles in the optical microscope images with the application of 1 MHz electric field at strength of 100 V/mm (a), 1 kHz at strength of 50 V/mm (b) and 1 kHz at strength of 100 V/mm (c).

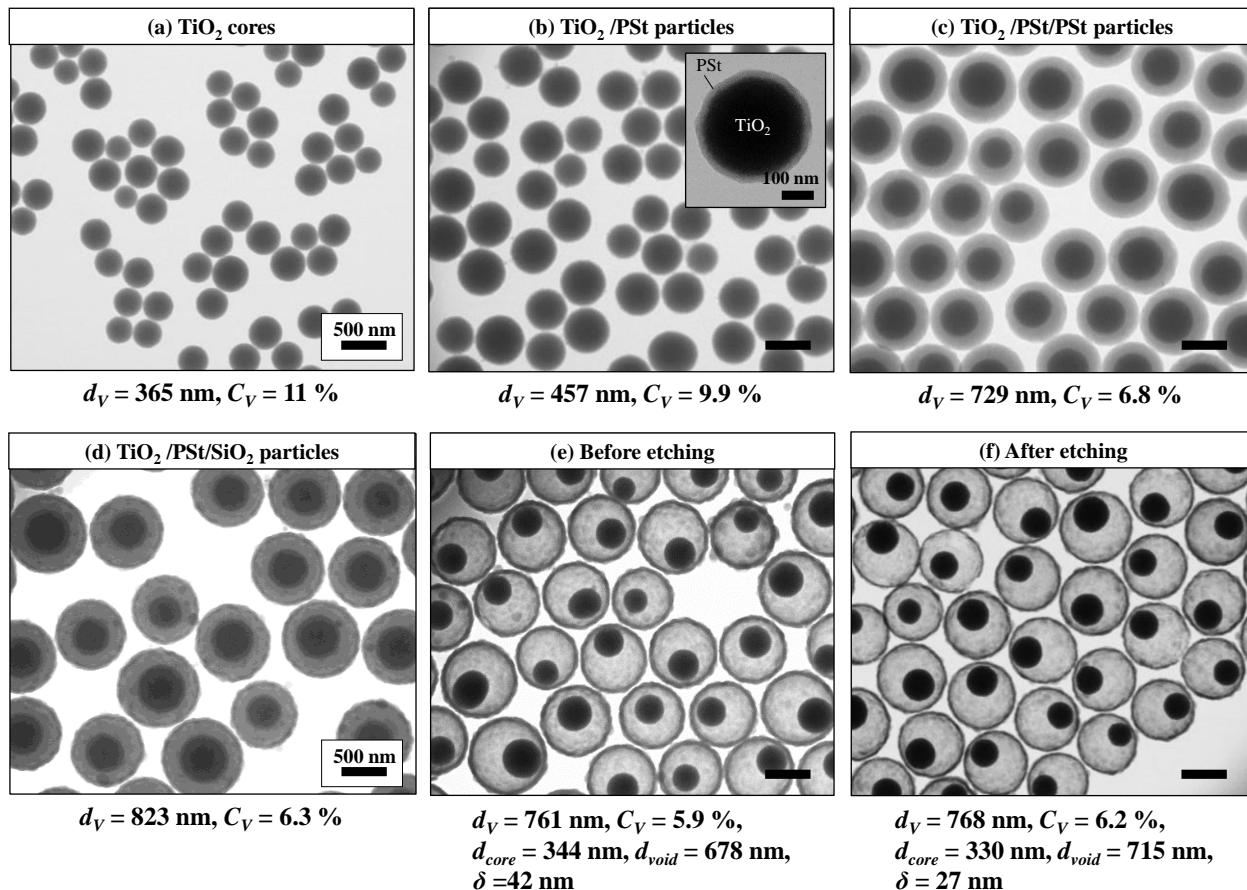


Figure S7. TEM images of particles formed in the synthesis of yolk/shell particles incorporating a titania core.

(a) TiO₂ cores, (b) TiO₂/PSt particles, (c) TiO₂/PSt/PSt particles, (d) Silica-coated core/shell particles, (e) Particles obtained by calcination of the particles (d), and (f) Particles obtained by the slight etching of particles (e).

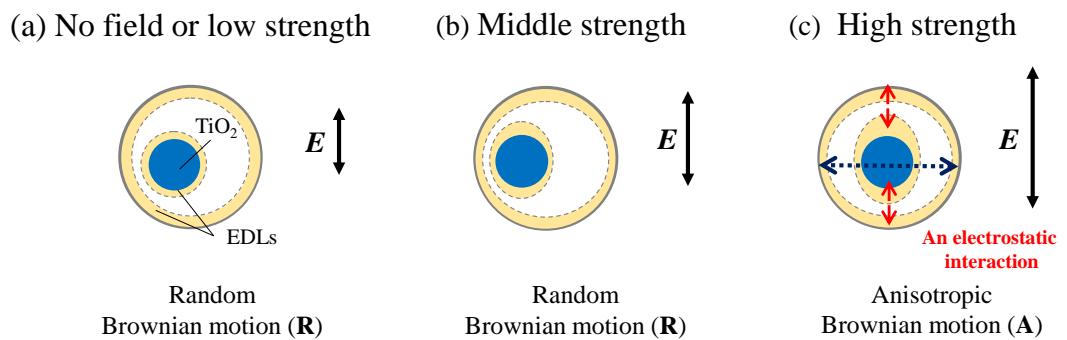


Figure S8. Schematic images of EDLs covering titania cores and shells ($d_{void}/d_{core} = 2.2$) with 0 or low strength (a), middle strength (b) and high strength (c).