SUPPORTING INFORMATION

Photonic Crystal Microbubbles as Suspension Barcodes

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Supplementary Discussion

1. Calculation of the density of the PhC microbubbles

The density of the PhC bubbles could be pre-determined through changing the flow rates during the generation of microcapsules templates to match with the detection mixture so as to keep them suspended in practical application. Considering the generation process of the particles, the overall density of these PhC bubbles could be estimated as follows:

$$\rho = \frac{m}{V} = \frac{m_{PS}+m_{ETPTA}}{V_{core}+V_{shell}} = \frac{F_i\,t\,\omega+F_m\,t\,\rho_E}{F_i\,t+F_m\,t} \tag{4}$$

where ρ and ρ_E represents the overall density of the PhC bubbles and the density of ETPTA, respectively; ω is the mass volume fraction of the PS nanoparticles in the colloidal suspension. F_i and F_m represent the volume flow rates of the inner and middle streams in the microfluidic emulsification process. t is the time. Through simplification, the following equation could be deduced as:

$$\frac{F_m}{Fi} = \frac{\rho-\omega}{\rho_{E-}\rho} \tag{5}$$

therefore, through adjustment of the flow rates, the overall density of the PhC bubbles could be pre-determined as desired to match that of a certain detection solution (ρ_S). In this case, ρ_E=1.12 g/mL, and we chose water as a model solution so that let $\rho = \rho_S$=1 g/mL. Thus, we drew two theoretical curves of the relationship between F_i and F_m based on equation (3), with variations of the mass volume fraction of nanoparticles (ω), respectively. When $\omega = 10\ wt\%$, F_m=7.5F_i; when $\omega = 20\ wt\%$, F_m=6.67F_i. The experimental data were consistent with these calculations (**Figure S4**).

2. Supplementary Figures

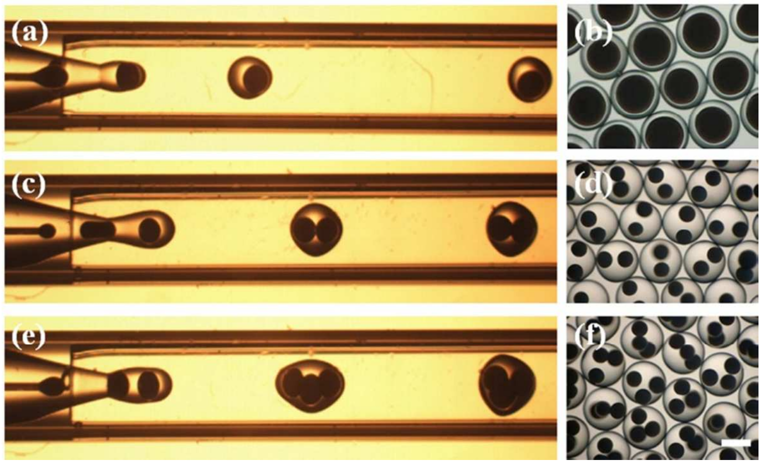

Figure S1. (a, c, e) Real-time images of the glass capillary microfluidic fabrication of double emulsions. (b, d, f) Microscope photographs of the corresponding monodisperse microcapsules with one, two, and three cores, respectively. The scale bar is 300μm.

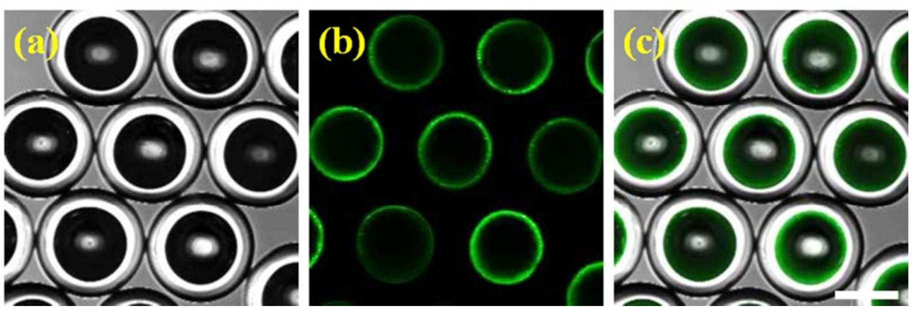

Figure S2. CLSM images of the PhC microbubbles, indicating that the PhC shell was uniform. The scale bar is 300μm.

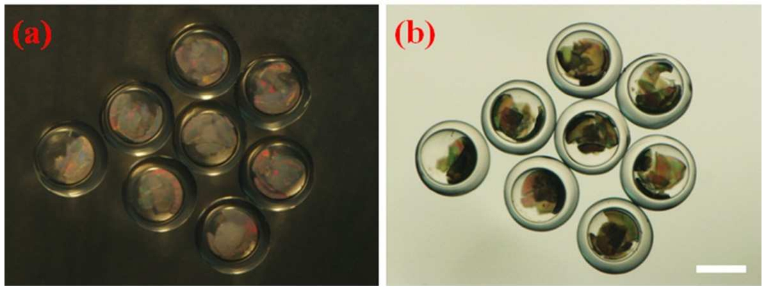

Figure S3. Colloidal nanoparticles assembly through dry and evaporation of water in the core of the microcapsules. The colloidal photonic crystals tend to form a thick layer on the bottom, and the film was cracked in some case. The scale bar is 300μm.

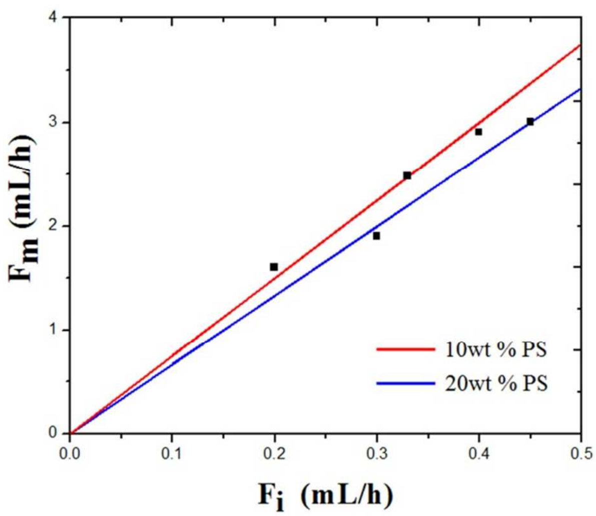

Figure S4. The density tunability of the PhC microbubbles. Adjustment of the flow rates of the inner and middle phases to make the overall density of the PhC balloons matches that of the detection solution (ρ_S). In this case, $\rho_E = 1.12$, and $\rho_S = 1$. The two curves were drawn based on equation (3), with variations of the mass volume fraction of nanoparticles, respectively. The experimental data depicted by the dots were consistent with this calculation.

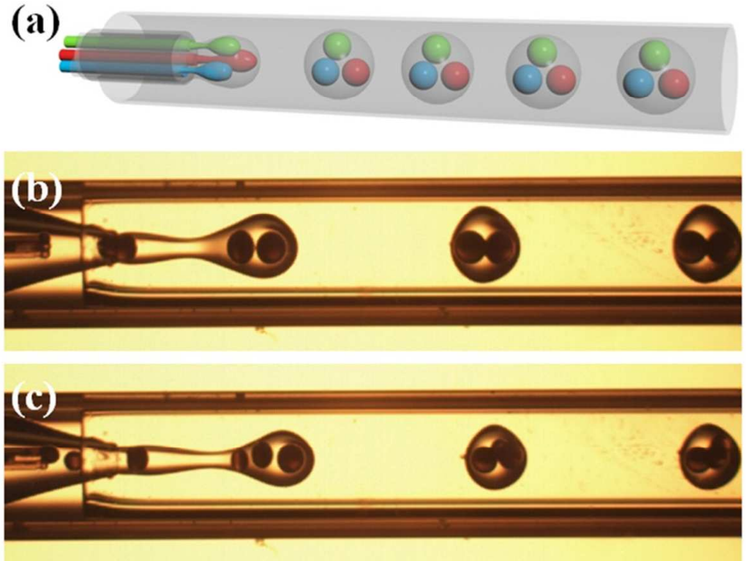

Figure S5. (a) Schematic illustration and (b-c) real-time images of the microfluidic generation of multi-compartmental double emulsions. By selectively injecting different inner phases or by adjusting the flow rates, the core number and different combinations of component could be controlled.

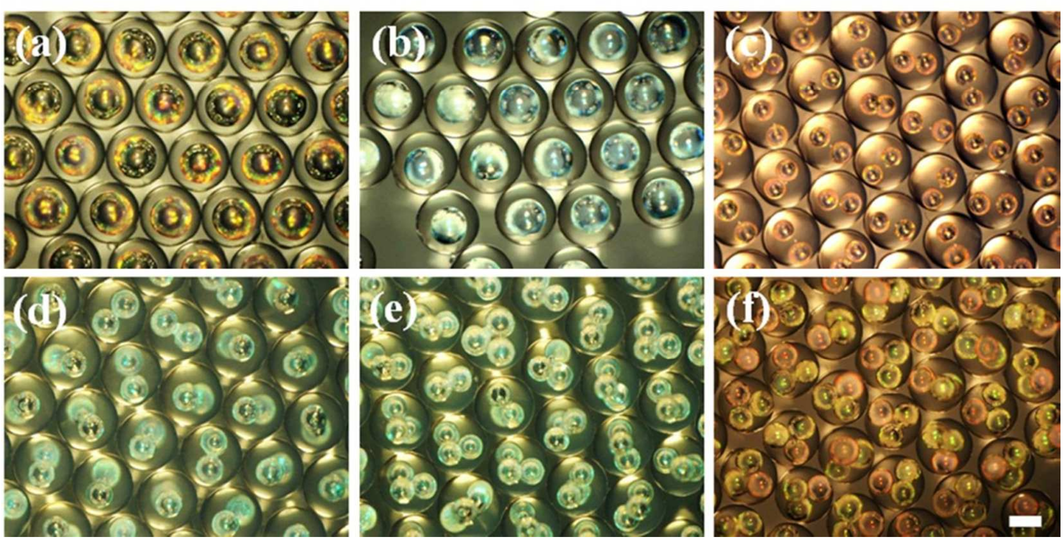

Figure S6. PhC microbubbles for different color combinations. The scale bar is 300μm

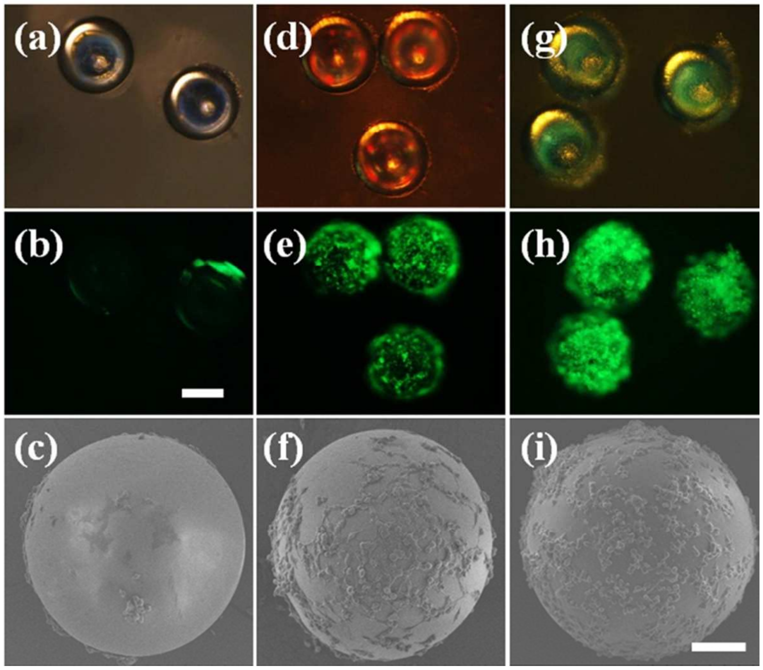

Figure S7. (a-c) Blue particles without any surface modification. The scale bar is 300 µm; (d-f) Green particles decorated with colloidal silica arrays on the surface; (g-i) Red particles with colloidal silica arrays on the surface and covered by collagen. The scale bar is 100 µm.

3. Supplementary Movie

Movie S1. Artificially puncturing the microparticle and observation of the release of microbubble from the microparticle.(The evidence of the existence of the encapsulated bubble)

Movie S2. Magnetically controllable motion of PhC balloons ($R_1G_1M_2$). These particles rotated and were pulled to one side of a disk under the guidance of magnetic field.