# Supporting Information

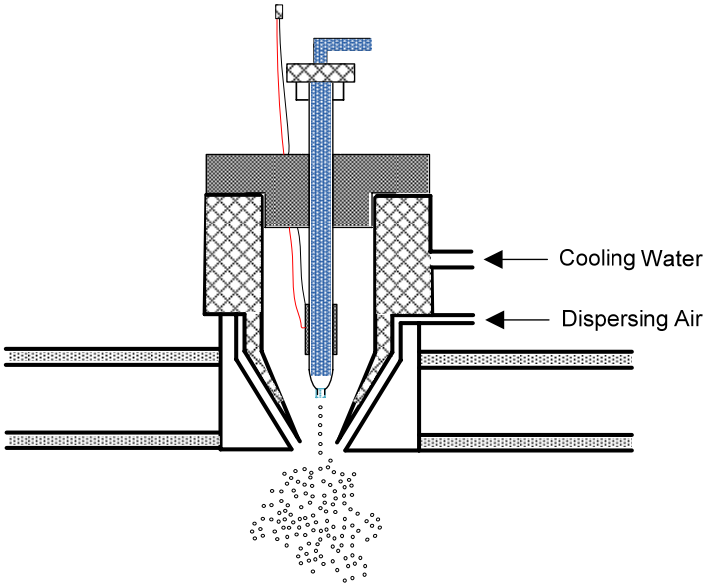


Fig. S1 Schematic diagram of droplets dispersion.

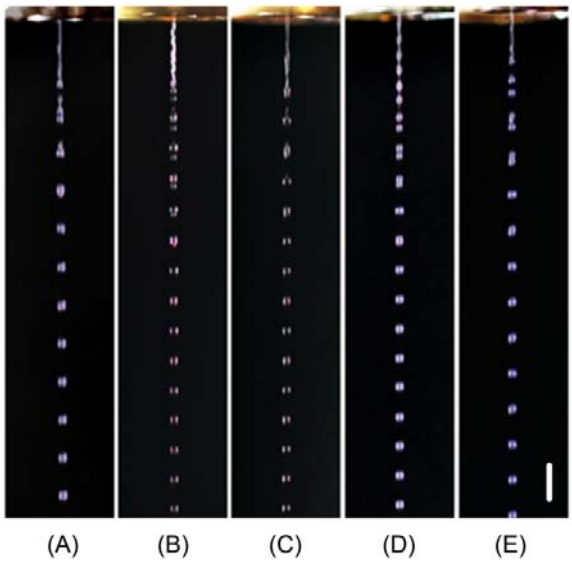


Fig. S2 Monodisperse droplets generated by MFAN: A. $R_3(H)$, B. $R_3(H_1A_2)$, C. $R_3(H_1A_2E_{0.5})$, D. $R_{2.5}C_{0.5}(H)$, and E. $R_{2.5}T_{0.5}(H)$. (Scale bar: 5mm).

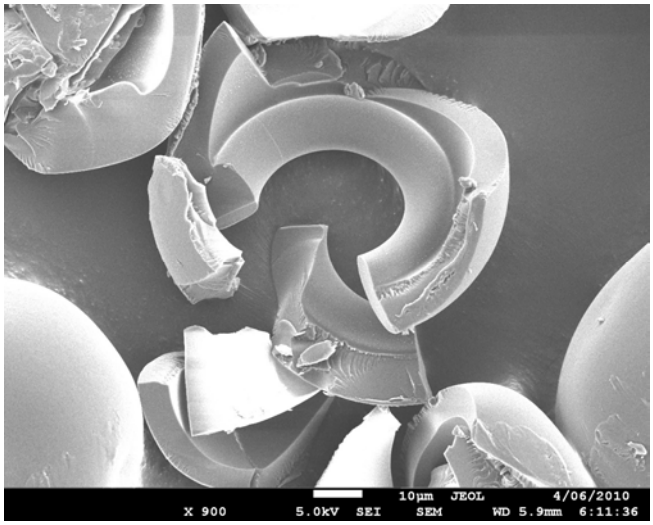


Fig. S3 The hollow structure of $R_3$(H) microparticles. (Scale bar: 10 μm)

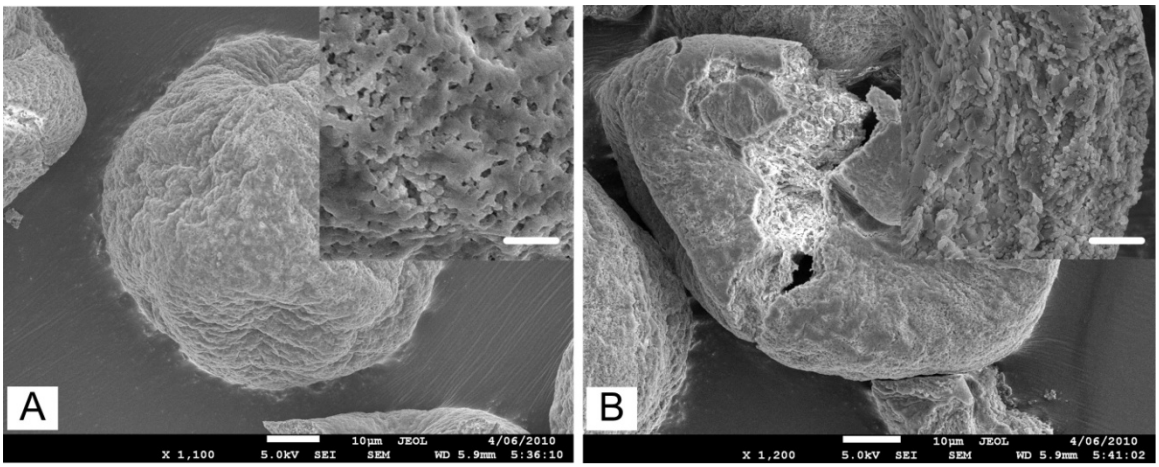


Fig. S4 The surface characteristic and inner structure of $R_{2.5}C_{0.5}$(H) microparticles after drug release test at pH 1.2. (The microparticles showed eroded characteristics after release test due to solubility of chitosan in acidic condition). (Scale bar of main picture: 10 µm; scale bar of inset: 2 µm)

**Drug release kinetic studies.**

The drug release data were analysed with the empirical equation proposed by Peppas and Sahlin:[1]

$$\frac{M_t}{M_\infty} = k_1 \cdot t^m + k_2 \cdot t^{2 \cdot m}$$

where $\frac{M_t}{M_\infty}$ was the fraction of drug released at time $t$, and $k_1$, $k_2$, and $m$ were constants. In the equation, $k_1 \cdot t^m$ represents the Fickian diffusional contribution ($F$), whereas the second term ($k_2 \cdot t^{2m}$) represents the case-II relaxational contribution ($R$). The value of $R/F$ ratio presents the percentage contributions of Fickian diffusion and relaxation and has been used as an effective tool to identify the drug release mechanism of controlled release systems.[2, 3] Figure S5 illustrated the $R/F$ ratio values plotted versus release time for the microparticles fabricated from different conditions.

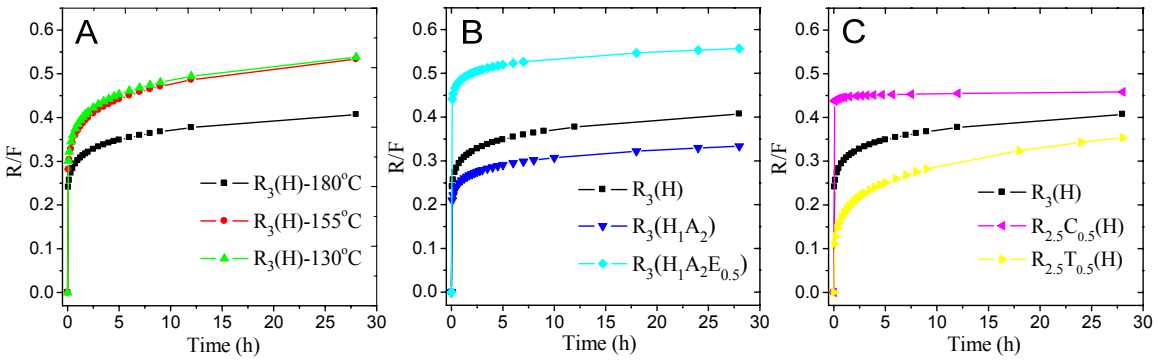


Fig. S5 $R/F$ ratio values versus release time for the spray dried microparticles.

For microparticles spray dried at different drying temperatures (Figure S5A), the $R/F$ value increased with decreasing drying temperature, indicating the enhanced relaxational contribution. This result implys that the easier water penetration resulted from higher

initial moisture content of microparitcles obtained at lower drying temperature promotes the relaxational contribution.

For the microparticles fabricated with different solvents (Figure S5B), the release of $R_3(H_1A_2E_{0.5})$ microparticles showed the increasing extent of relaxational contribution than $R_3(H)$ microparticles, which could be explained by the different particle structures. As shown in Figure 7, $R_3(H_1A_2E_{0.5})$ microparticles maintained a relatively compact surface structure (Figure $7C_1$) during release tests, while $R_3(H)$ particles formed visible pores on the surface (Figure $7A_1$), which facilitated and enhanced the Fickian diffusion. $R_3(H_1A_2)$ showed the lowest R/F values, indicating the dominant diffusion-dependent release mechanism, which can be ascribed to the much larger specific surface area compared to $R_3(H)$, $R_3(H_1A_2E_{0.5})$ particles.

For the microparticles fabricated using different dopants, they displayed quiet diffenent release kinetics (Figure S5C). The release of ($R_{2.5}C_{0.5}(H)$) microparticles showed enhanced relaxational contribution than the $R_3(H)$ microparticles. The incorporation of chitosan improved the hydrophilicity of microparticles, thus facilitating water penetration and rendering relatively large relaxational contribution. On the contrary, $R_{2.5}T_{0.5}(H)$ microparticles showed apparent diffusion-controlled release behavior (very low $R/F$ Value). The visible pores on particle surface (Figure $12B_1$) formed by the silica network degradation significantly highlighted the Fickian diffusion contribution.

(1) Peppas, N. A.; Sahlin, J. J. *International Journal of Pharmaceutics* **1989,** 57, (2), 169-172.

(2) Bettini, R.; Colombo, P.; Massimo, G.; Catellani, P. L.; Vitali, T. *European Journal of Pharmaceutical Sciences* **1994,** 2, (3), 213-219.

(3) Siepmann, J.; Peppas, N. A. *Advanced Drug Delivery Reviews* **2001,** 48, (2-3), 139-157.