Electronic Supplementary Information for:

Co-Axial Capillaries Microfluidic Device for Synthesizing Size- and Morphology-Controlled Polymer Core-Polymer Shell Particles

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Operating conditions:

Fig. 2: Top, Q_I = 0.0012 mL.min^{-1}; Q_M = 0.005 mL.min^{-1}; Q_O = 0.06 mL.min^{-1}. Bottom, Q_I = 0.0035 mL.min^{-1}; Q_M = 0.004 mL.min^{-1}; Q_O = 0.05 mL.min^{-1}. Prepared in system I.

Fig. 3: (a) Q_O = 0.07 mL.min^{-1} and Q_M = 0.005 mL.min^{-1} in microfluidic system I; Q_O = 0.06 mL.min^{-1} and Q_M = 0.005 mL.min^{-1} in microfluidic system II; μ_O = 1500 cP; (b) Q_O = 0.07 mL.min^{-1} and Q_I = 0.0012 mL.min^{-1} in microfluidic system I; Q_O = 0.06 mL.min^{-1} and Q_I = 0.0032 mL.min^{-1} in microfluidic system II; μ_O = 1500 cP; (c) Q_M = 0.005 mL.min^{-1} and Q_I = 0.0012 mL.min^{-1} in microfluidic system I; Q_M = 0.005 mL.min^{-1} and Q_I = 0.0032 mL.min^{-1} in microfluidic system II; μ_O = 1500 cP; (d) Q_O = 0.07 mL.min^{-1}, Q_M = 0.005 mL.min^{-1} and Q_I = 0.0012 mL.min^{-1} in microfluidic system I; Q_O = 0.06 mL.min^{-1}, Q_M = 0.005 mL.min^{-1} and Q_I = 0.0032 mL.min^{-1} in microfluidic system II; μ_O = 1500 cP.

Fig. 5: μ_O = 1500 cP, Q_O = 0.07 mL.min^{-1}; Q_M = 0.006 mL.min^{-1}; Q_I = 0.004 mL.min^{-1}(a,a'); Q_I = 0.0006 mL.min^{-1}(b,b'); Q_I = 0.0008 mL.min^{-1}(c,c') in microfluidic system I, Δ= -650 µm.

Table ESI.1 Sizes of the capillaries and experimental materials

		System I			System II			System III			System IV			System V			System VI		
Cappilary size		Inner diameter	Outer diameter	Material	Inner diameter	Outer diameter	Material	Inner diameter	Outer diameter	Material	Inner diameter	Outer diameter	Material	Inner diameter	Outer diameter	Material	Inner diameter	Outer diameter	Material
	Inner capillary	20 µm	90 µm	Glass	75 µm	360 µm	PEEK	100 µm	165 µm	Glass	150 µm	360 µm	PEEK	100 µm	360 µm	PEEK	100 µm	165 µm	Glass
	Middle capillary	150 µm	360 µm	PEEK	700 µm	850 µm	Glass	300 µm	760 µm	PTFE	700 µm	850 µm	Glass	530 µm	670 µm	Glass	250 µm	360 µm	Glass
	Outlet tubing	1600 µm	3200 µm	PTFE	1600 µm	3200 µm	PTFE	1600 µm	3200 µm	PTFE	1600 µm	3200 µm	PTFE	1600 µm	3200 µm	PTFE	1600 µm	3200 µm	PTFE
Inner fluid phase		acrylamide, 10 wt %; NN'-methylene-bisacrylamide, 1.5 wt %; Ammonium persulfate, 0.15 wt			acrylamide, 10 wt %; NN'-methylene-bisacrylamide, 1.5 wt %; Ammonium persulfate, 0.15 wt			acrylamide, 10 wt %; NN'-methylene-bisacrylamide, 1.5 wt %; Ammonium persulfate, 0.15 wt			acrylamide, 10 wt %; NN'-methylene-bisacrylamide, 1.5 wt %; Ammonium persulfate, 0.15 wt			acrylamide, 10 wt %; NN'-methylene-bisacrylamide, 1.5 wt %; Ammonium persulfate, 0.15 wt			distilled water		
		viscosity: 1.45 cP			viscosity: 1.45 cP			viscosity: 1.45 cP			viscosity: 1.45 cP			viscosity: 1.45 cP			viscosity: 0.98 cP		
Middle fluid phase		tripropylenglykol-diacrylate, 93 wt %; Span80, 3.5% 1-hydroxycyciohexyl phenyl ketone,			tripropylenglykol-diacrylate, 93 wt %; Span80, 3.5% 1-hydroxycyciohexyl phenyl ketone,			tripropylenglykol-diacrylate, 93 wt %; Span80, 3.5% 1-hydroxycyciohexyl phenyl ketone,			tripropylenglykol-diacrylate, 93 wt %; Span80, 3.5% 1-hydroxycyciohexyl phenyl ketone,			tripropylenglykol-diacrylate, 93 wt %; Span80, 3.5% 1-hydroxycyciohexyl phenyl ketone,			tripropylenglykol-diacrylate, 93 wt %; Span80, 3.5% 1-hydroxycyciohexyl phenyl ketone,		
		viscosity: 14.2 cP			viscosity: 14.2 cP			viscosity: 14.2 cP			viscosity: 14.2 cP			viscosity: 14.2 cP			viscosity: 14.2 cP		
Outer fluid phase		aqueous solution of methyl cellulose			aqueous solution of methyl cellulose			aqueous solution of methyl cellulose			aqueous solution of methyl cellulose			aqueous solution of methyl cellulose			aqueous solution of methyl cellulose		
		No.	viscosity (cP)		No.	viscosity (cP)		No.	viscosity (cP)		No.	viscosity (cP)		No.	viscosity (cP)		No.	viscosity (cP)	
		1	500		1	500		1	1300		1	1300		1	1300		1	1300	
		2	800		2	800		-	-		-	-		-	-		-	-	
		3	1100		3	1100		-	-		-	-		-	-		-	-	
		4	1400		4	1400		-	-		-	-		-	-		-	-	
		5	1600		5	1600		-	-		-	-		-	-		-	-	
		6	2000		6	2000		-	-		-	-		-	-		-	-	

Table ESI 2. Maximum standard errors (SE_{max}, given in µm) of experimental data plotted in Figure 3

Graph	**Data symbol**					
	●	○	★	▲	Δ	■
3a	12.65	9.09	12.87	8.33	7.14	8.69
3b	11.77	10.52	11.08	5.45	9.36	9.33
3c	13.21	9.74	10.39	10.02	7.77	9.91
3d	10.63	13.92	11.6	7.38	6.64	6.37

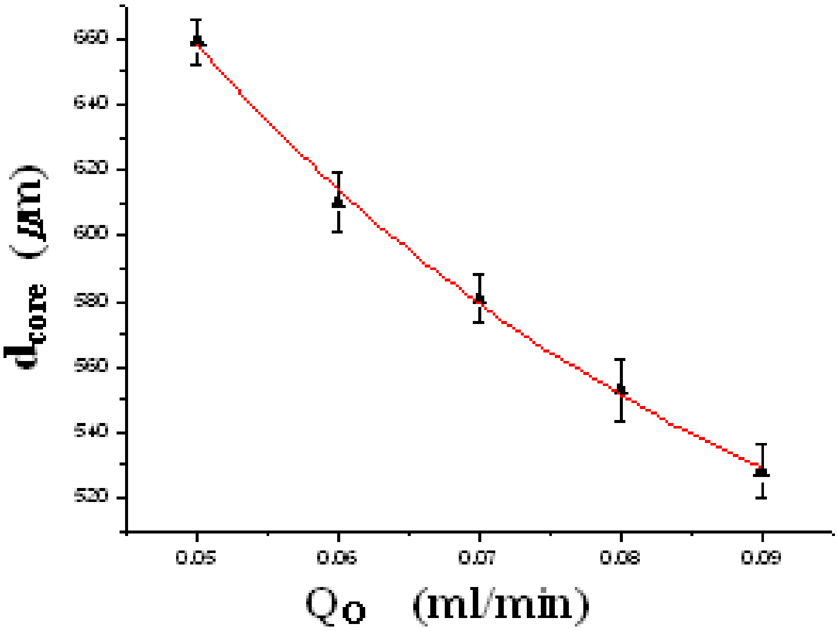

Fig. ESI.1 Variation of the core droplet diameter with respect to the outer fluid flow rate at constant Q_O/Q_M.

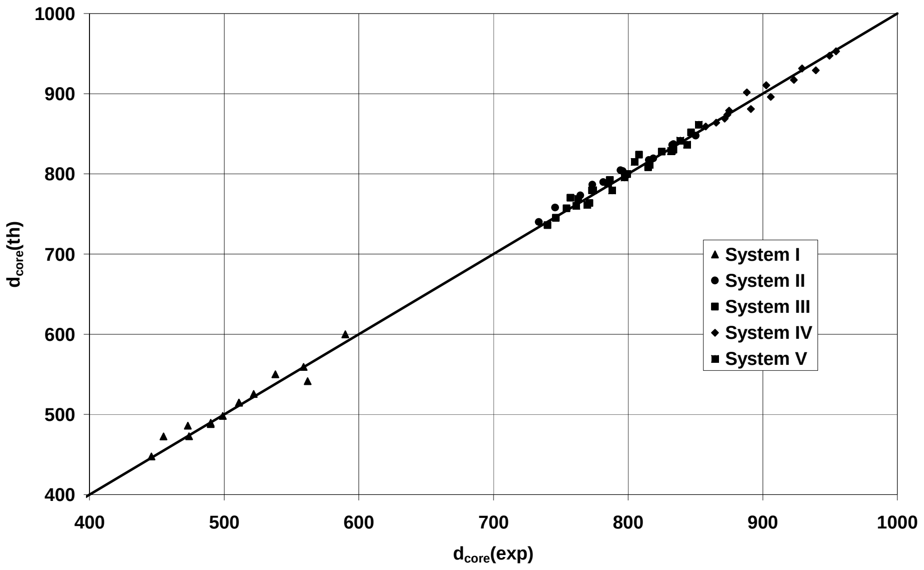

Fig. ESI.2 Comparison between theoretical (th) and experimental (exp) core droplet diameter for the 5 systems tested. Solid line represents the first bisector.

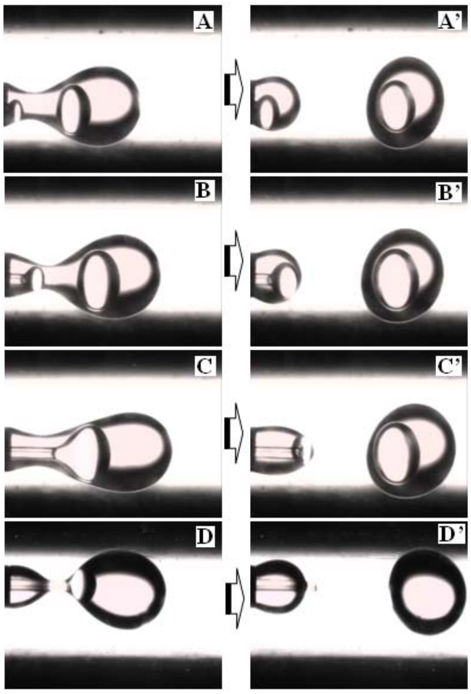

Fig. ESI.3 Snapshots of the formation of core-shell droplets for different positive capillaries' tips relative position, Δ=0 (A,A'); Δ=146 μm (B,B'); Δ=360 μm (C,C'); Δ=480 μm (D,D'). Experimental conditions: Q_O = 0.07 mL.min^{-1}; Q_M = 0.006 mL.min^{-1}; Q_I = 0.0012 mL.min^{-1} in microfluidic system I, μ_O = 1500 cP.

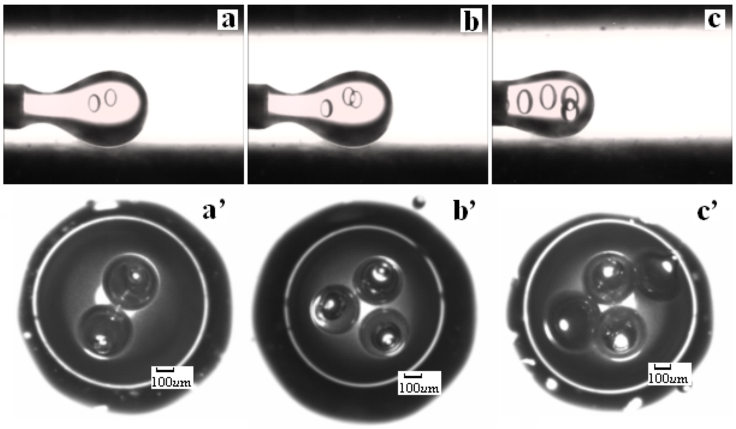

Fig. ESI.4 Optical microscopy images of the multiple core droplet formation in a co-axial capillaries microfluidic device with a negative capillaries' tips relative position (top) and the multiple poly(acrylamide) core-poly(tripropylenglycol-diacrylate) shell particles obtained (bottom), core being labeled with an acqueous dye (Nigrosin, Aldrich). Experimental conditions: μ_O = 1500 cP, Q_O = 0.07 mL.min^{-1}; Q_M = 0.006 mL.min^{-1}; Q_I = 0.004 mL.min^{-1}(a,a'); Q_I = 0.0006 mL.min^{-1}(b,b'); Q_I = 0.0008 mL.min^{-1}(c,c') in microfluidic system I, Δ= -650 µm.

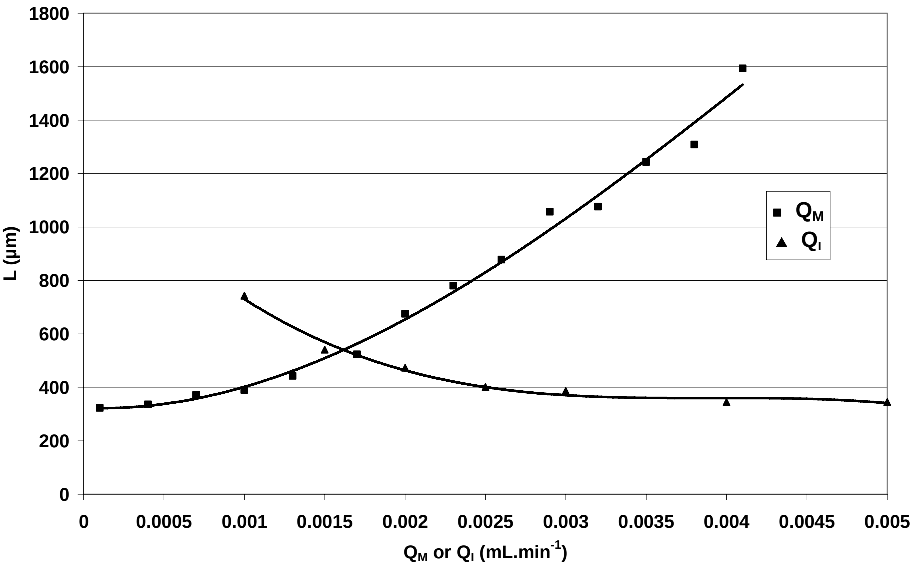

Fig. ESI.5 Effects of the inner and middle fluid flow rates on the length of rod-like polymer particles obtained with microfluidic system VI (Q_I = 0.0023 mL.min^{-1} when Q_M is varying from 0.0001 mL.min^{-1} to 0.006 mL.min^{-1}; Q_M = 0.0045 mL.min^{-1} when Q_I is varying from 0.0025 mL.min^{-1} to 0.014 mL.min^{-1}; Q_O = 0.05 mL.min^{-1}).

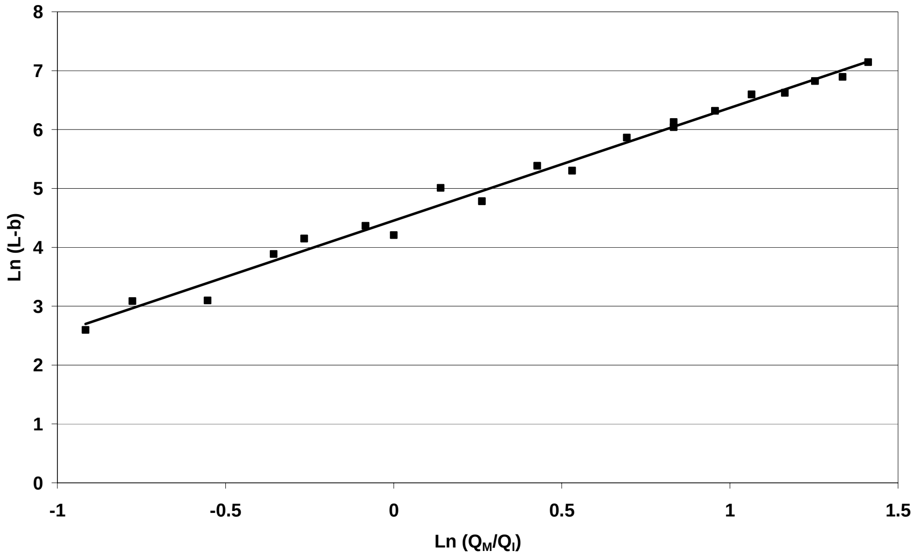

Fig. ESI.6 Variations of the length of rod-like polymer particles with respect to the ratio between the middle and inner fluid flow rates. Solid line is derived from equation 4.