

Supporting Information

Molecular Weight Distribution of Polymers Produced by Anionic Polymerization Enables Mixability Evaluation

Yuta Endo,^{1,2} Mai Furusawa,^{1,3} Toshiya Shimazaki,^{1,4} Yusuke Takahashi,⁶ Yuichi Nakahara,^{1,5} and Aiiichiro Nagaki^{1,6*}

¹ Micro Chemical Production Study Consortium in Kyoto University, Kyoto University, Nishikyo-ku, Kyoto 615-8510, Japan, ² Isolation And Purification Group, Process Development Section, Process Development Labs, Research Institute For Bioscience Products & Fine Chemicals, Ajinomoto Co., Inc., 1-1 Suzuki-cho, Kawasaki-ku, Kanagawa 210-8681, Japan, ³ Oppama Research Laboratory, Toho Chemical Industry Co., Ltd., 5-2931, Urago-cho, Yokosuka-shi, Kanagawa 237-0062, Japan, ⁴ Tacmina Co. 2-2-14 Awajimachi, Chuo-ku, Osaka 541-0047, Japan, ⁵ New Frontiers Research Group, Frontier Research Labs., Institute For Innovation, Ajinomoto Co., Inc., 1-1 Suzuki-cho, Kawasaki-ku, Kanagawa 210-8681, Japan, ⁶ Department of Synthetic Chemistry and Biological Chemistry, Graduate School of Engineering, Kyoto University, Nishikyo-ku, Kyoto 615-8510, Japan

- Size exclusion chromatography data for all polymers with the calibration using standard polystyrene samples, and, explaining the results of Dushman reaction data -

Figure S-1. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-2. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-3. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-4. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-5. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-6. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-7. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-250-250 mixer, 30 degree-C)

Figure S-8. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-9. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-10. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-11. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-12. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-13. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-14. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-250-250 mixer, 0 degree-C)

Figure S-15. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, -20 degree-C)

Figure S-16. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, -20 degree-C)

Figure S-17. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, -20 degree-C)

Figure S-18. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, -20 degree-C)

Figure S-19. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, -20 degree-C)

Figure S-20. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-250 mixer, -20 degree-C)

Figure S-21. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-500-500 mixer, 30 degree-C)

Figure S-22. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-500-500 mixer, 30 degree-C)

Figure S-23. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-500-500 mixer, 30 degree-C)

Figure S-24. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-500-500 mixer, 30 degree-C)

Figure S-25. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-500-500 mixer, 30 degree-C)

Figure S-26. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-500-500 mixer, 30 degree-C)

Figure S-27. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, Y-250-250 mixer, 30 degree-C)

Figure S-28. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, Y-250-250 mixer, 30 degree-C)

Figure S-29. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, Y-250-250 mixer, 30 degree-C)

Figure S-30. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, Y-250-250 mixer, 30 degree-C)

Figure S-31. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, Y-250-250 mixer, 30 degree-C)

Figure S-32. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, Y-250-250 mixer, 30 degree-C)

Figure S-33. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-500 mixer, 30 degree-C)

Figure S-34. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-500 mixer, 30 degree-C)

Figure S-53. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

Figure S-54. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

Figure S-55. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

Figure S-56. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

Figure S-57. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

The reproducibility of anionic polymerization

Figure S-58. Comparing the Mw/Mn of 1st and 2nd trials

Table S-1. Numeric data of 2nd trial in the above graph

Explaining the results of Dushman reaction

Figure S-59. Comparing V-shape and T- shape mixers in Dushman reaction

Figure S-60. Comparing Y-shape and T- shape mixers in Dushman reaction

Table S-2. Numeric data of each graph in Dushman reaction

$M_n = 11492$
 $M_w = 13790$
 $M_z = 20174$
 $M_v = 13790$
 $I.V. = 13790$

$M_w/M_n = 1.20$ $M_z/M_n = 1.76$ $M_v/M_n = 1.20$

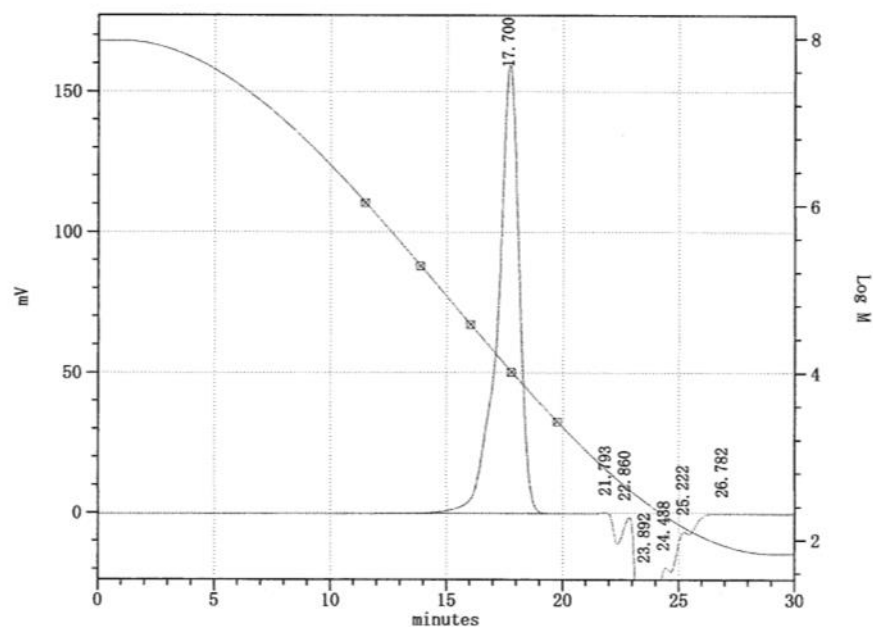


Figure S-1. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, 30 degree-C)

M_n = 11585
 M_w = 14105
 M_z = 20841
 M_v = 14105
 $I.V$ = 14105

M_w/M_n = 1.22 M_z/M_n = 1.80 M_v/M_n = 1.22

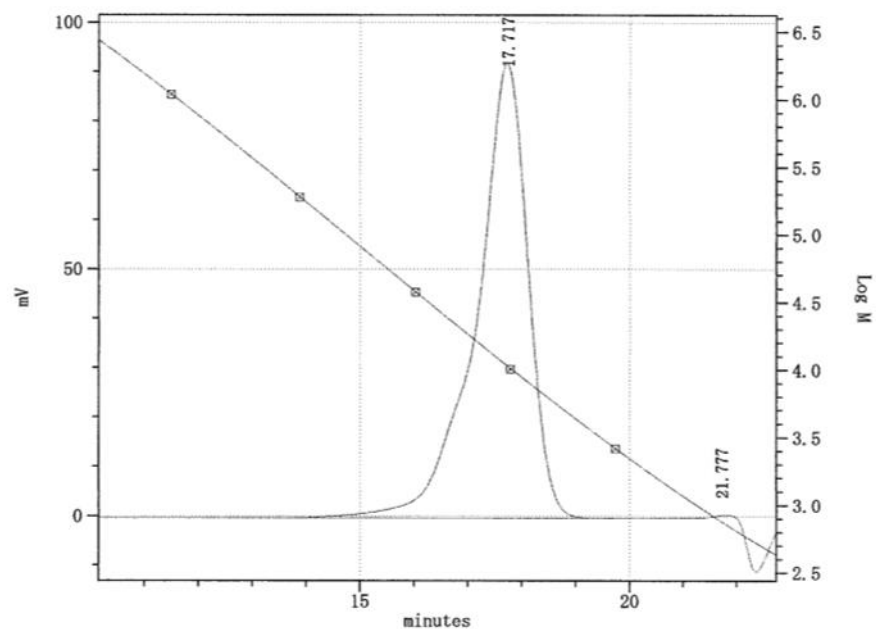


Figure S-2. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, 30 degree-C)

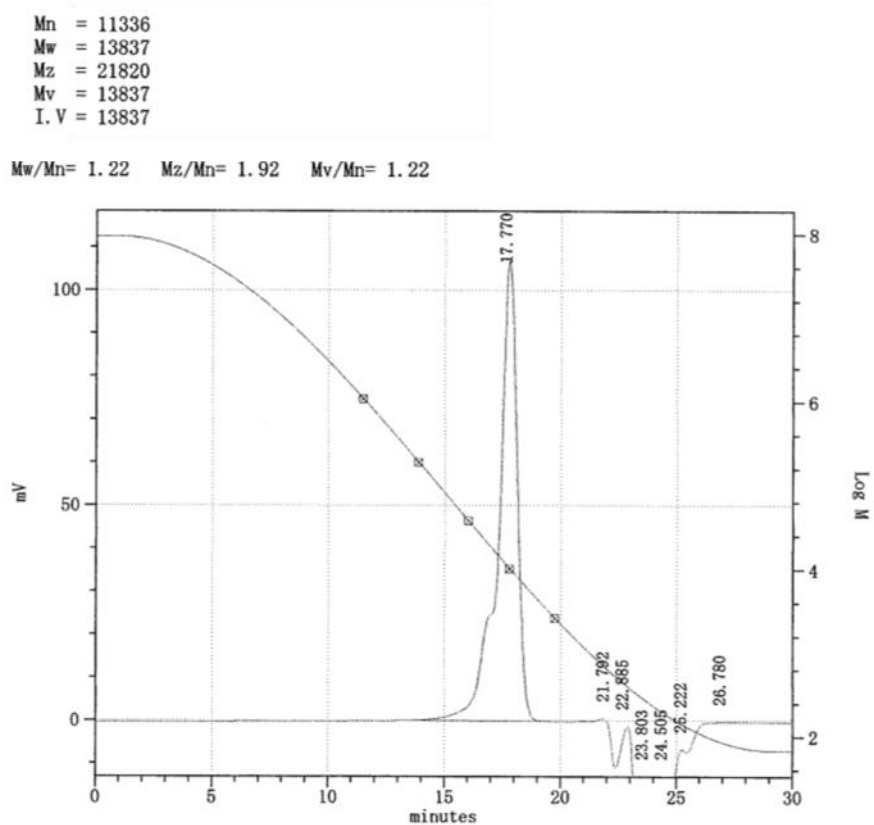


Figure S-3. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, 30 degree-C)

Mn	= 11214
Mw	= 13635
Mz	= 20628
Mv	= 13635
I. V	= 13635

Mw/Mn= 1.22 Mz/Mn= 1.84 Mv/Mn= 1.22

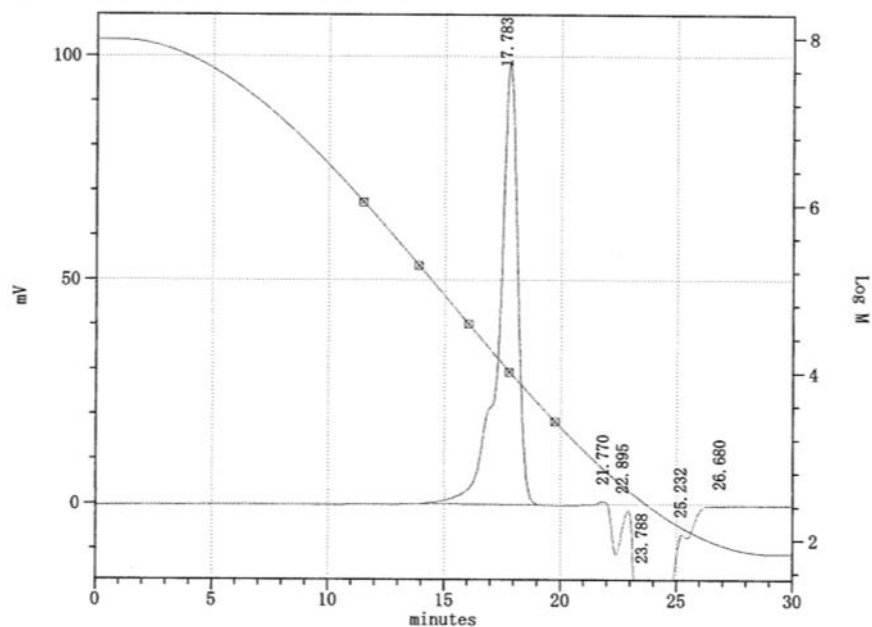


Figure S-4. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, 30 degree-C)

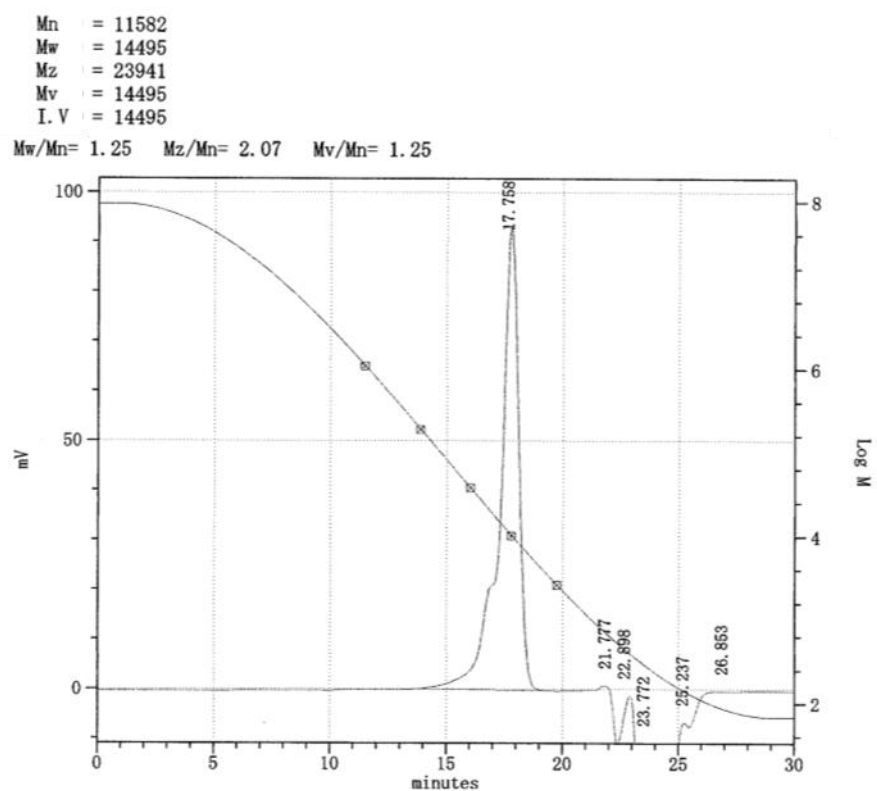


Figure S-5. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, 30 degree-C)

M_n = 11590
 M_w = 15673
 M_z = 33539
 M_v = 15673
 $I.V$ = 15673

M_w/M_n = 1.35 M_z/M_n = 2.89 M_v/M_n = 1.35

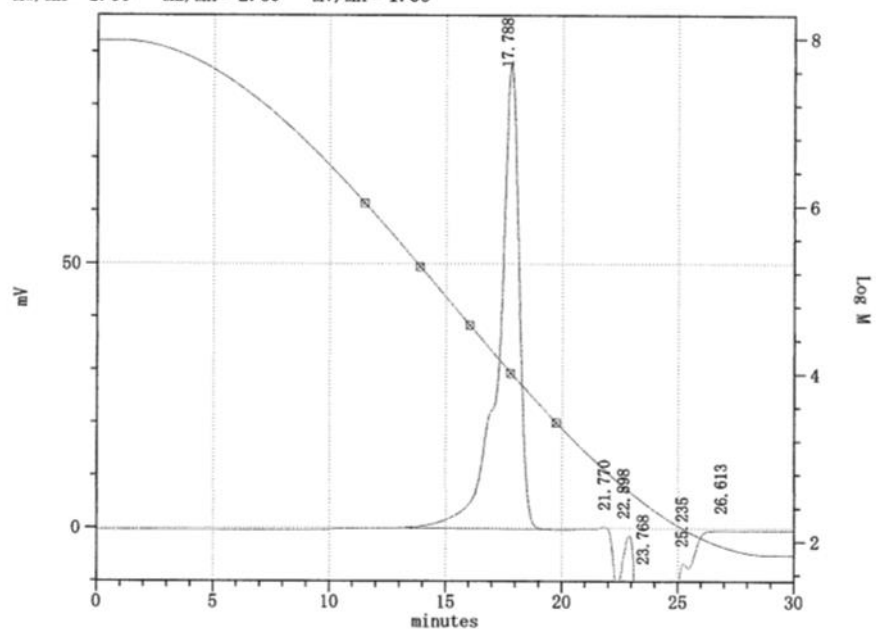


Figure S-6. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-250 mixer, 30 degree-C)

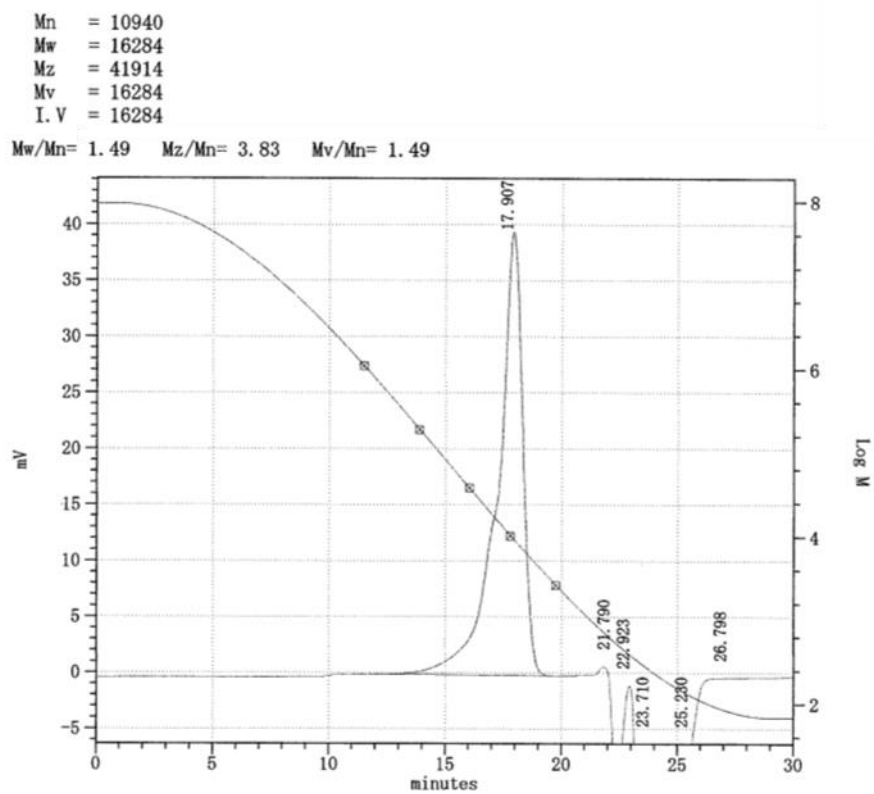


Figure S-7. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-250-250 mixer, 30 degree-C)

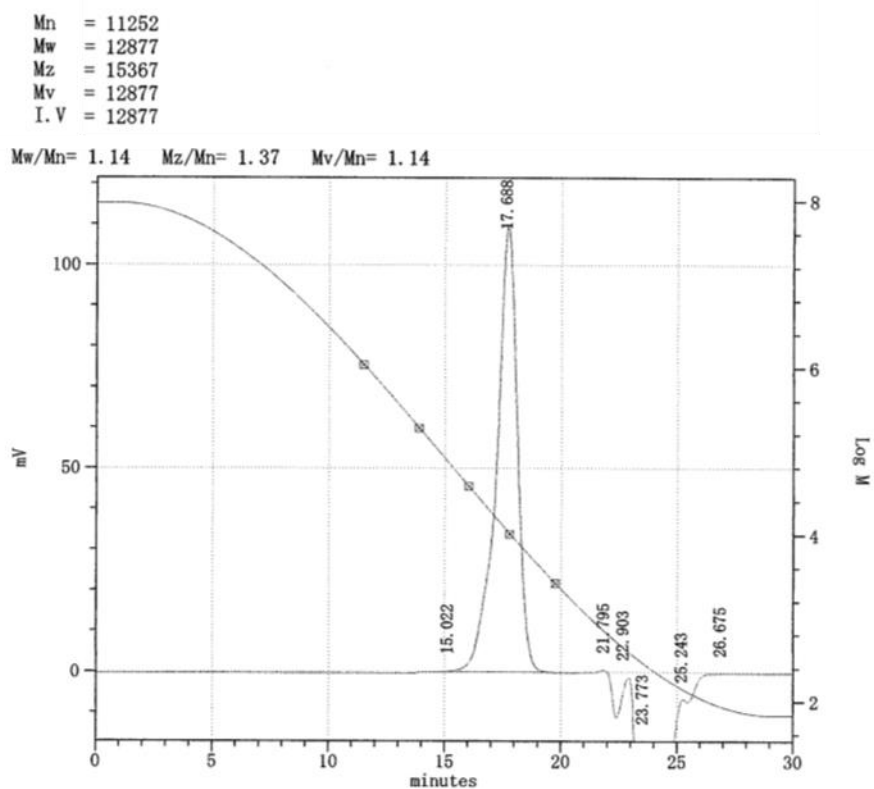


Figure S-8. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, 0 degree-C)

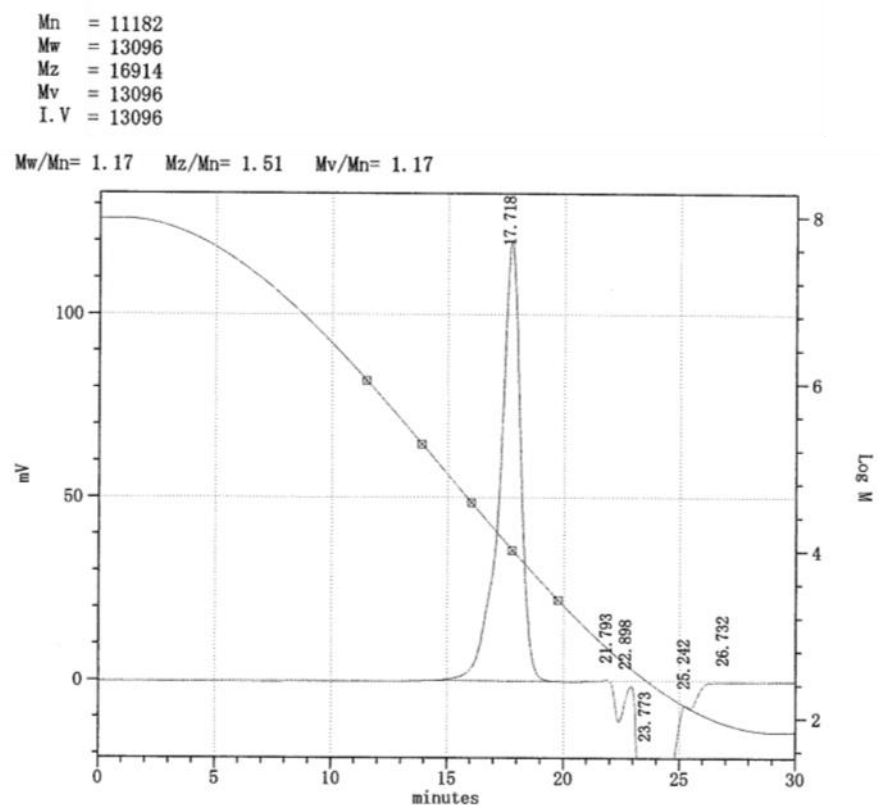


Figure S-9. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, 0 degree-C)

M_n = 11200
 M_w = 13532
 M_z = 19236
 M_v = 13532
 $I.V$ = 13532

M_w/M_n = 1.21 M_z/M_n = 1.72 M_v/M_n = 1.21

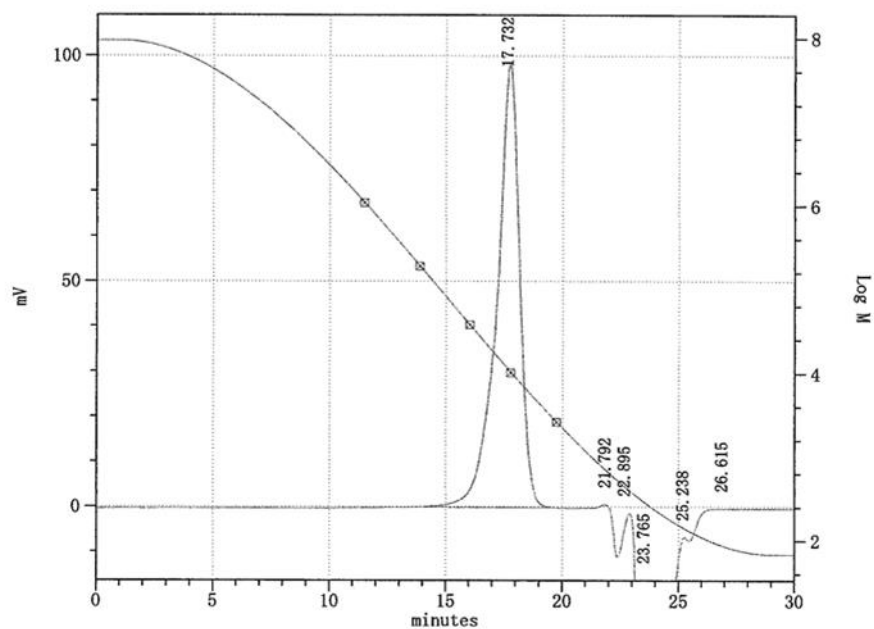


Figure S-10. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, 0 degree-C)

M_n = 11216
 M_w = 13569
 M_z = 19564
 M_v = 13569
 $I.V$ = 13569

M_w/M_n = 1.21 M_z/M_n = 1.74 M_v/M_n = 1.21

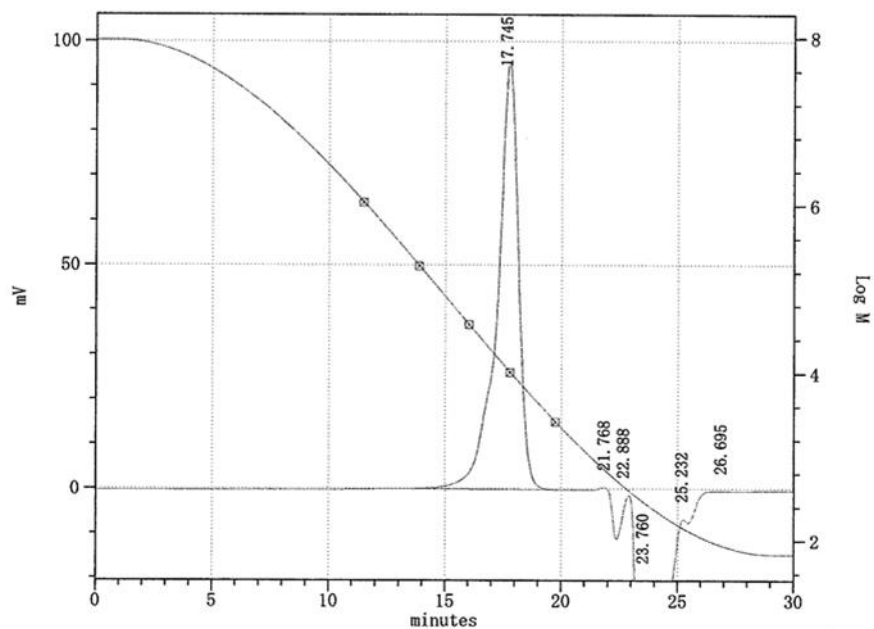


Figure S-11. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, 0 degree-C)

$M_n = 11239$
 $M_w = 14218$
 $M_z = 22783$
 $M_v = 14218$
 $I.V = 14218$

$M_w/M_n = 1.27$ $M_z/M_n = 2.03$ $M_v/M_n = 1.27$

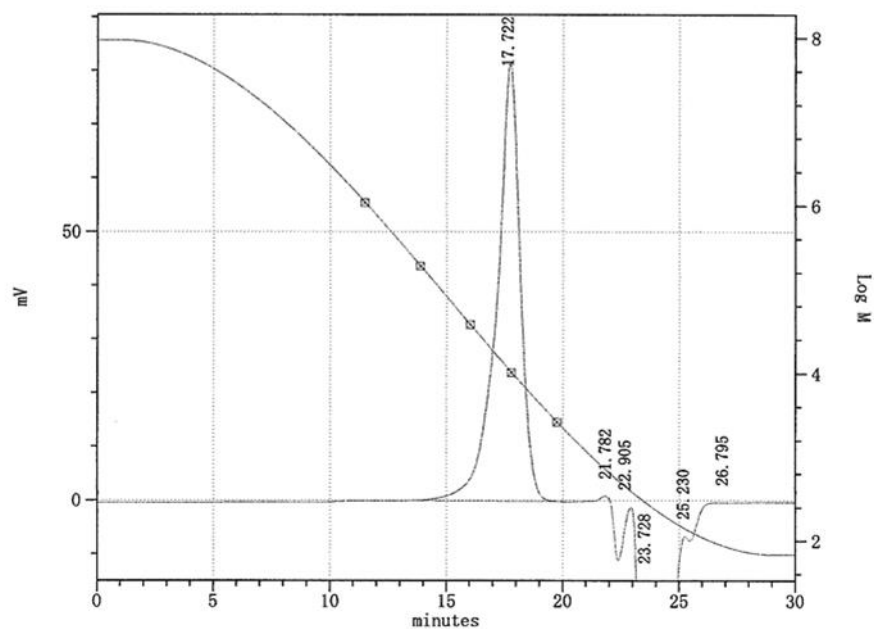


Figure S-12. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, 0 degree-C)

Mn	=	11101
Mw	=	14624
Mz	=	24235
Mv	=	14624
I. V	=	14624

Mw/Mn= 1.32 Mz/Mn= 2.18 Mv/Mn= 1.32

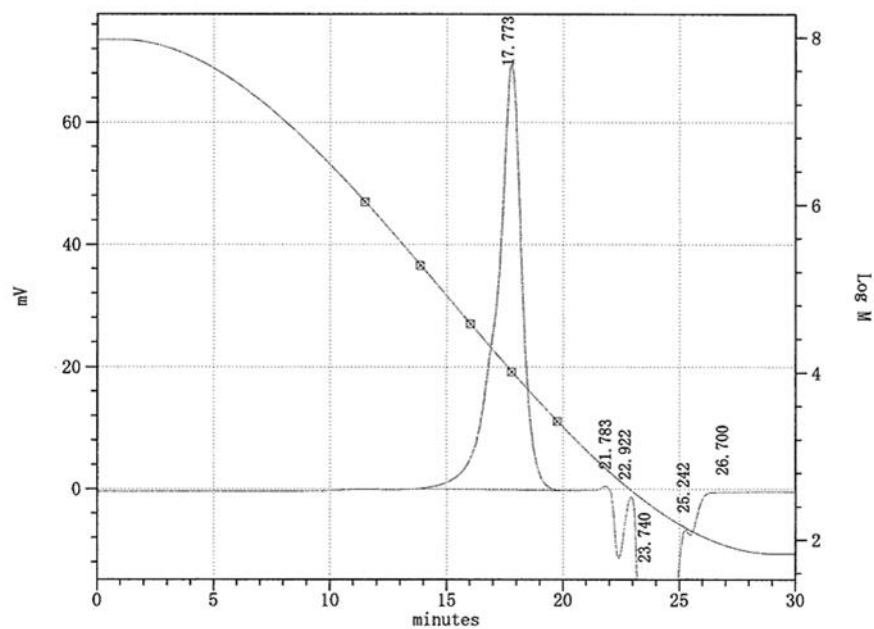


Figure S-13. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-250 mixer, 0 degree-C)

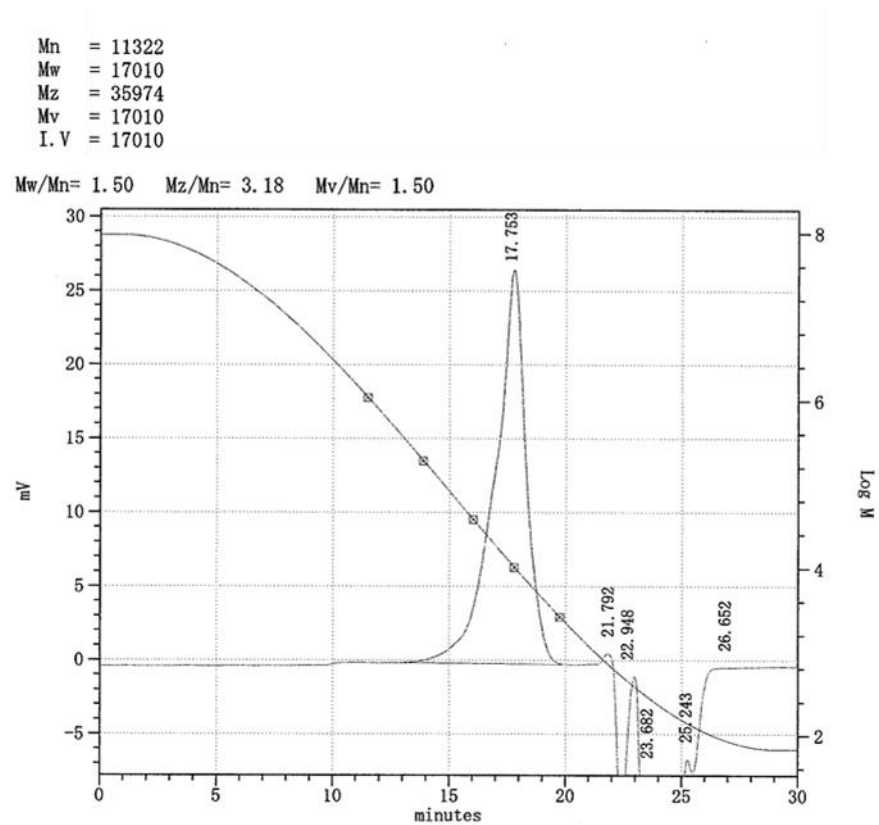


Figure S-14. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-250-250 mixer, 0 degree-C)

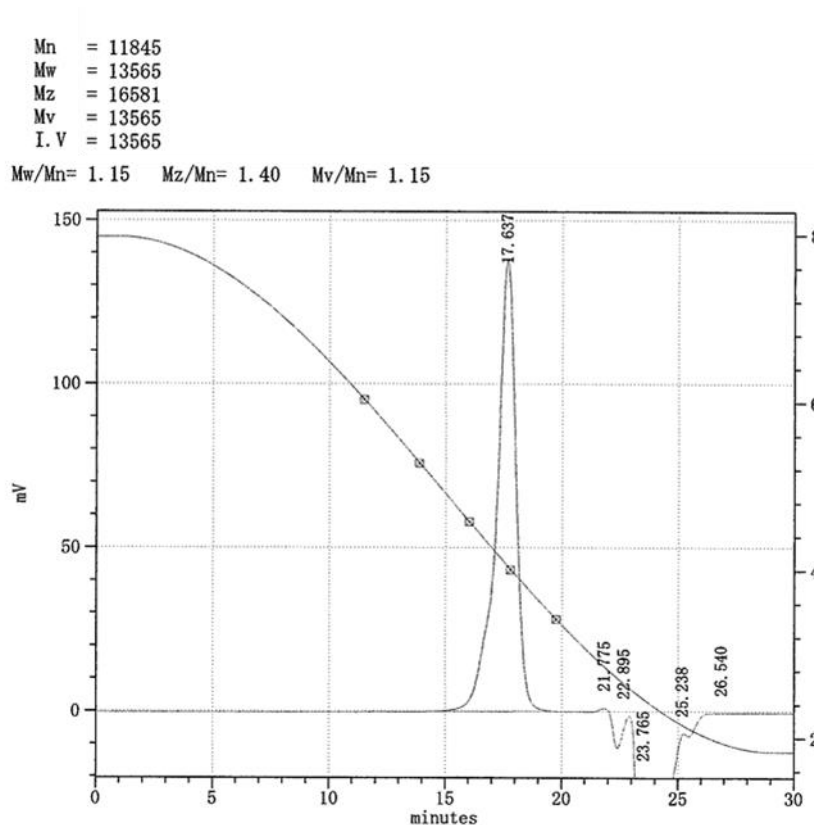


Figure S-15. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, -20 degree-C)

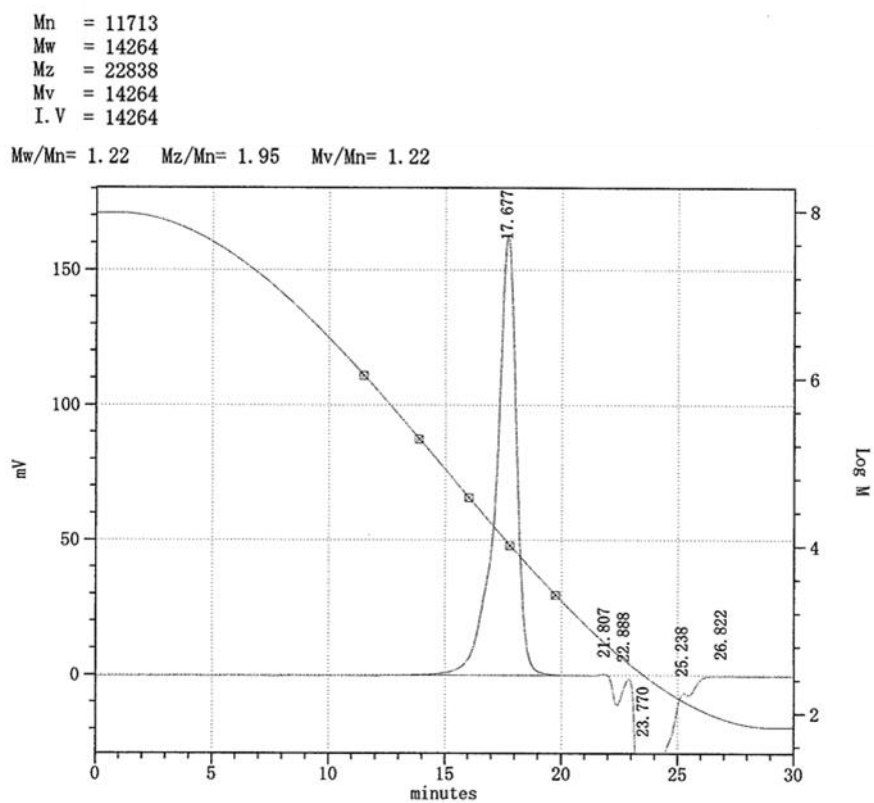


Figure S-16. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, -20 degree-C)

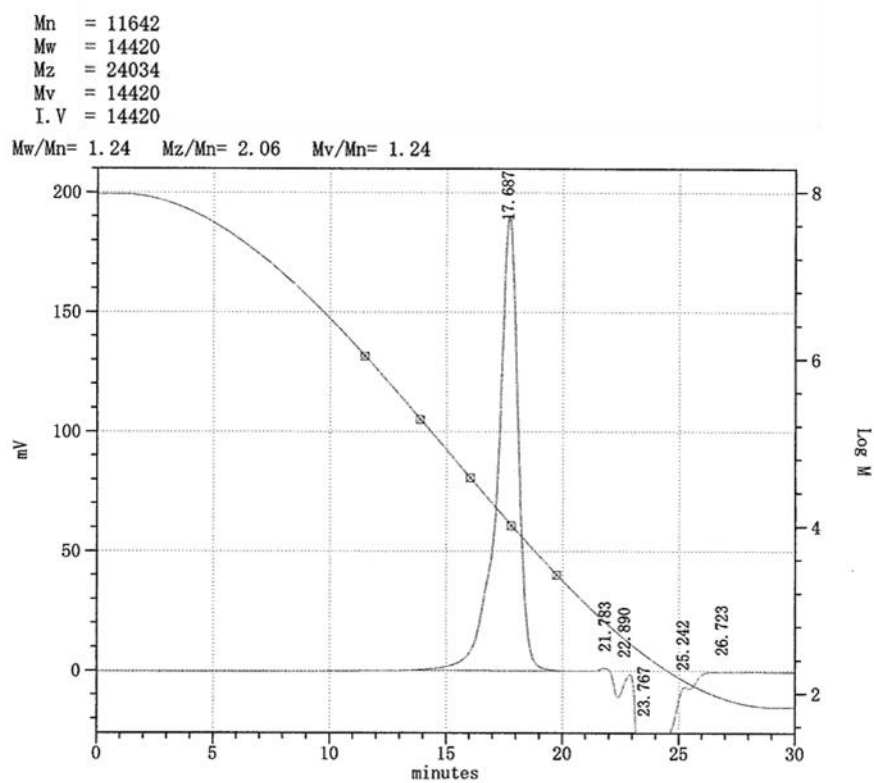


Figure S-17. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, -20 degree-C)

M_n = 11761
 M_w = 15544
 M_z = 37057
 M_v = 15544
 $I.V$ = 15544

M_w/M_n = 1.32 M_z/M_n = 3.15 M_v/M_n = 1.32

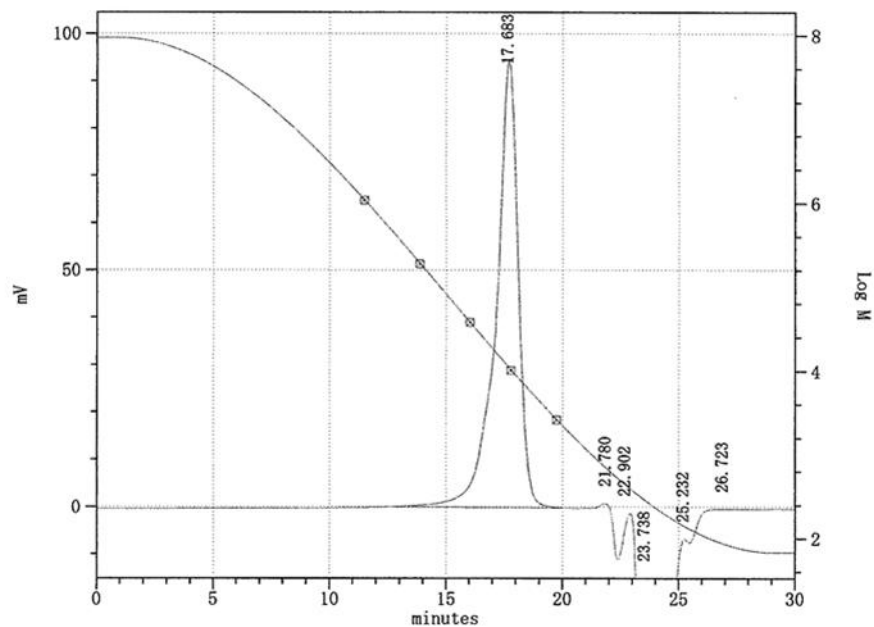


Figure S-18. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, -20 degree-C)

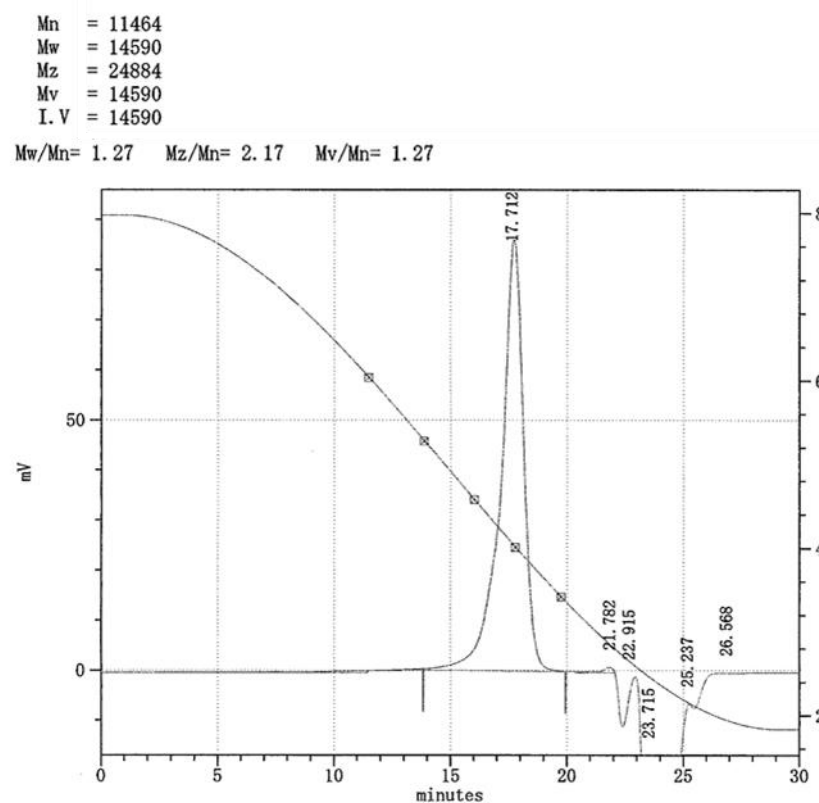


Figure S-19. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, -20 degree-C)

$M_n = 11308$
 $M_w = 15585$
 $M_z = 29801$
 $M_v = 15585$
 $I.V = 15585$

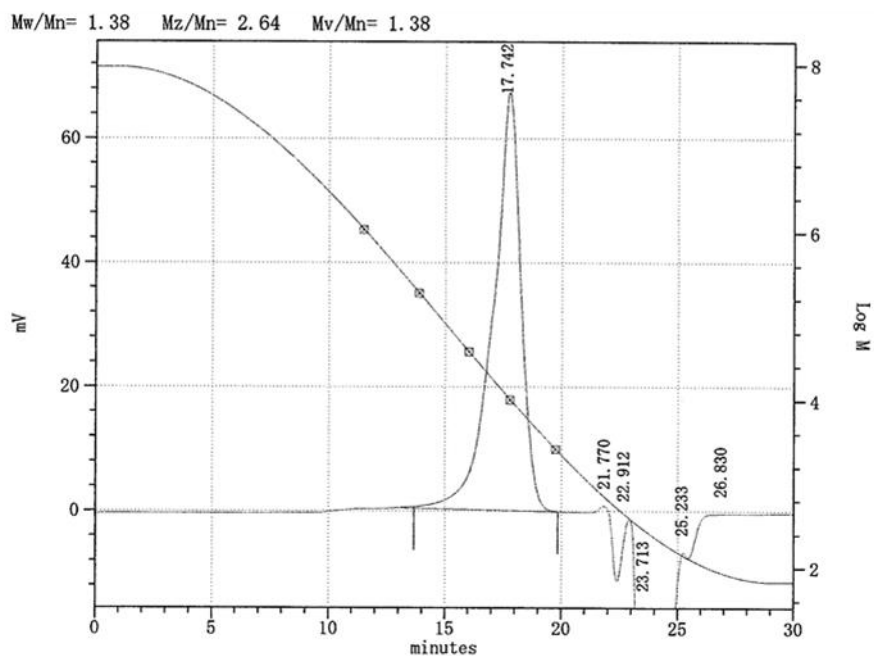


Figure S-20. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-250 mixer, -20 degree-C)

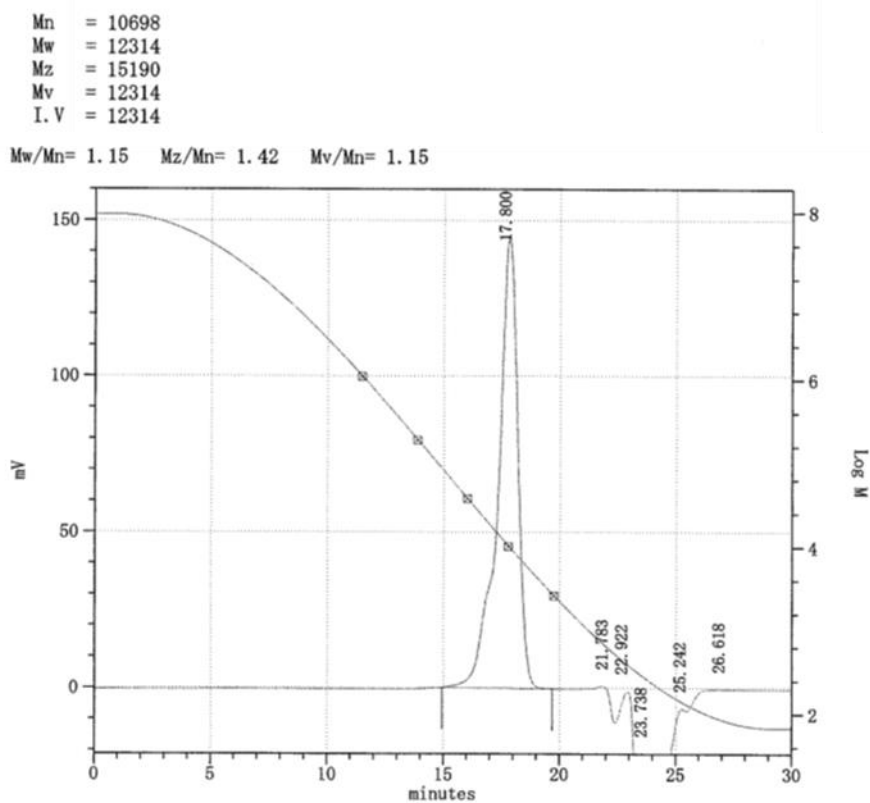


Figure S-21. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-500-500 mixer, 30 degree-C)

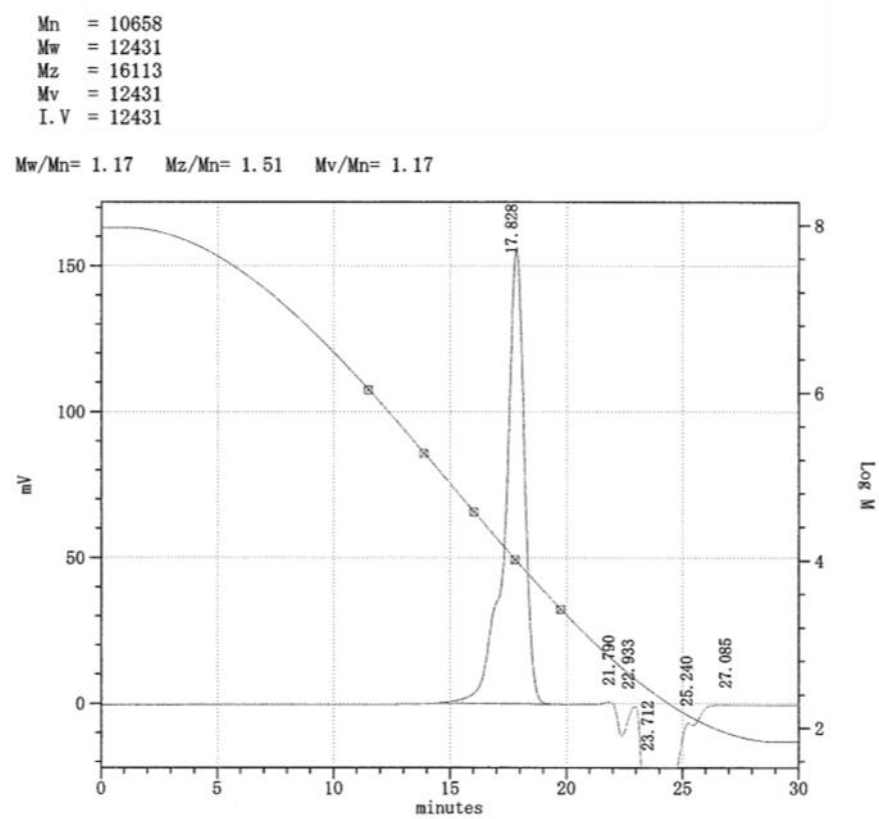


Figure S-22. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-500-500 mixer, 30 degree-C)

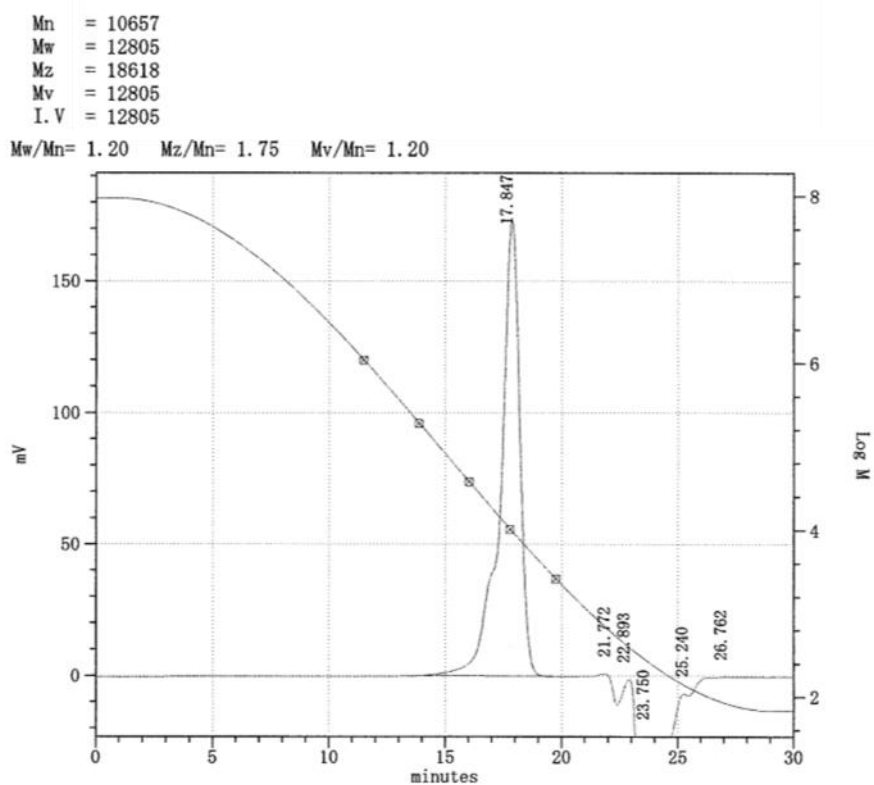


Figure S-23. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-500-500 mixer, 30 degree-C)

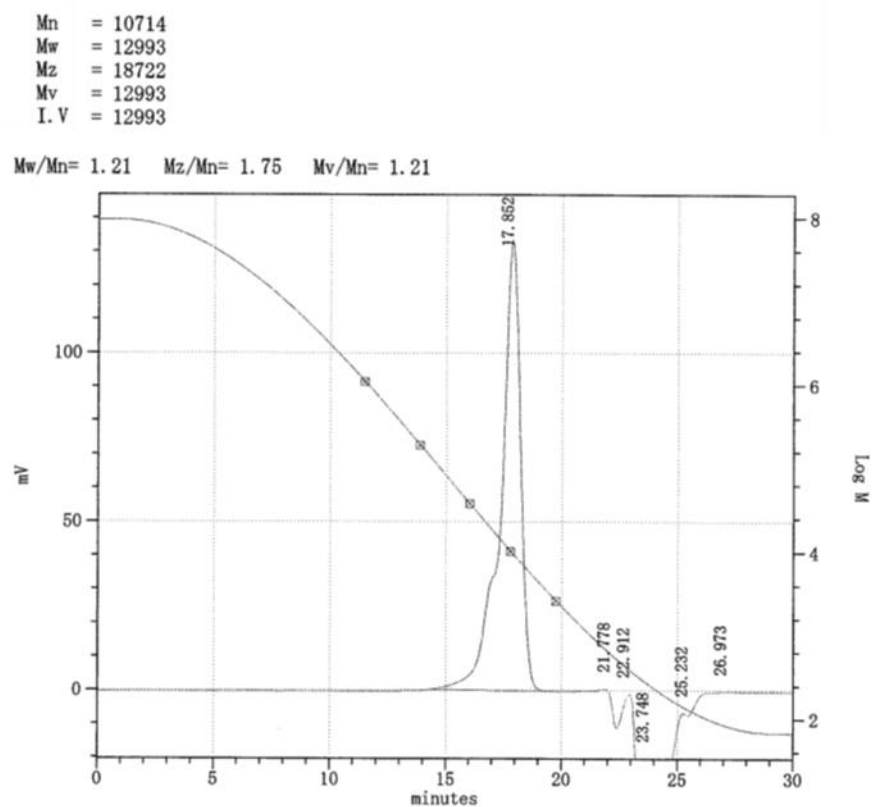


Figure S-24. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-500-500 mixer, 30 degree-C)

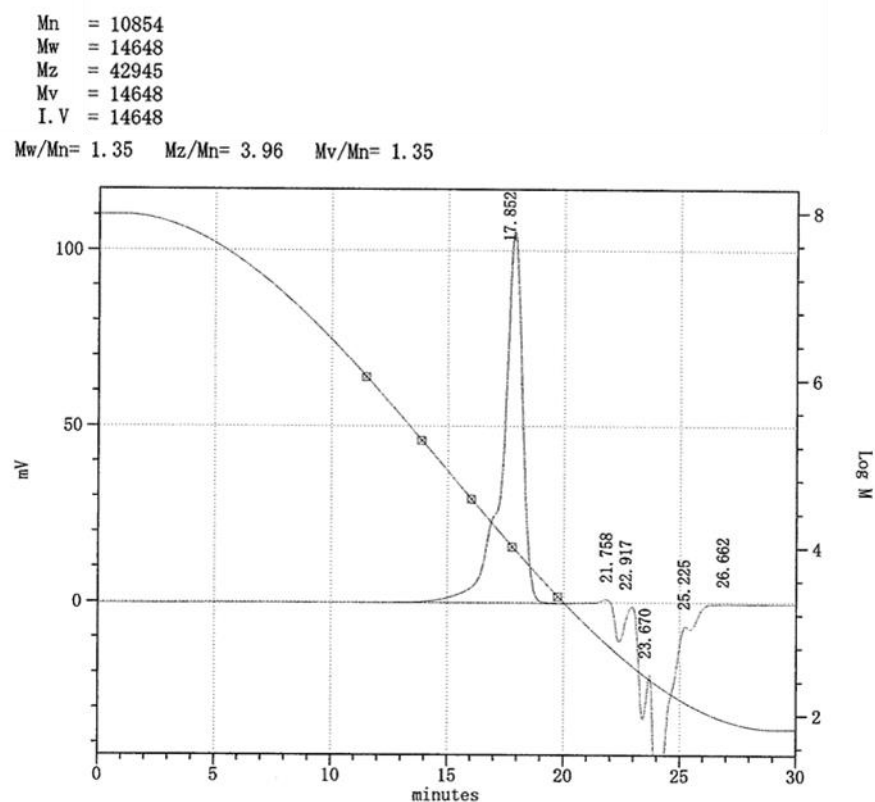


Figure S-25. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-500-500 mixer, 30 degree-C)

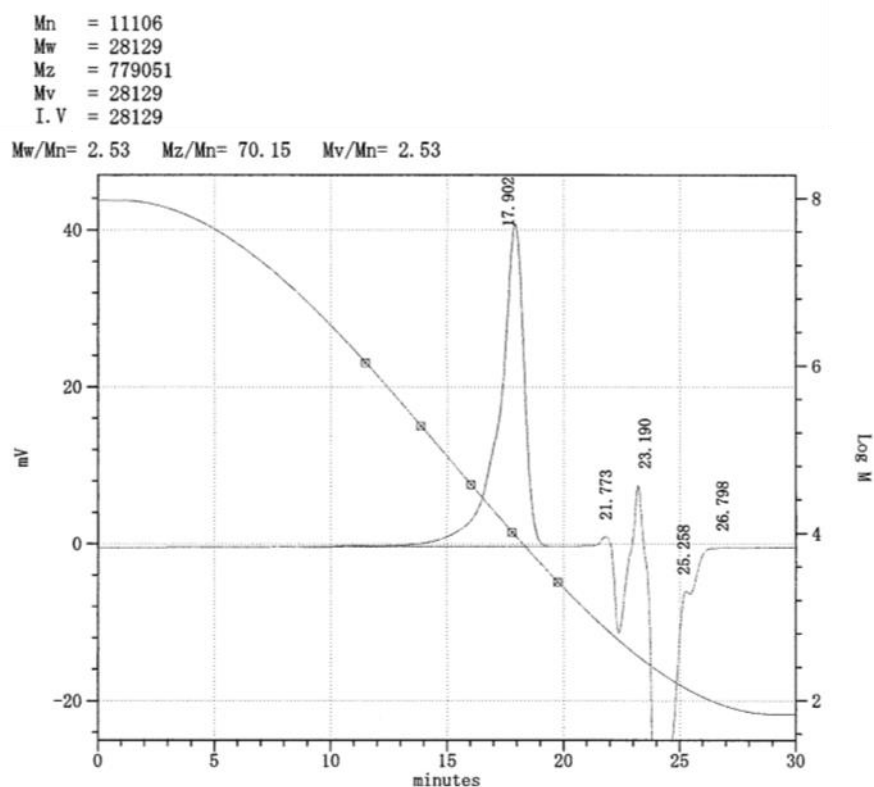


Figure S-26. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-500-500 mixer, 30 degree-C)

$M_n = 11027$
 $M_w = 12939$
 $M_z = 27949$
 $M_v = 12939$
 $I.V = 12939$

$M_w/M_n = 1.17$ $M_z/M_n = 2.53$ $M_v/M_n = 1.17$

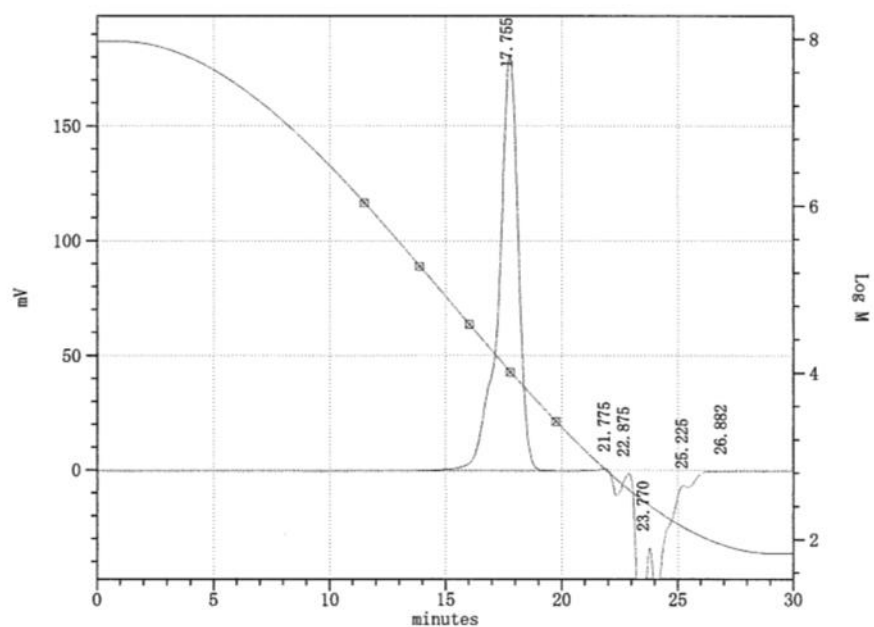


Figure S-27. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, Y-250-250 mixer, 30 degree-C)

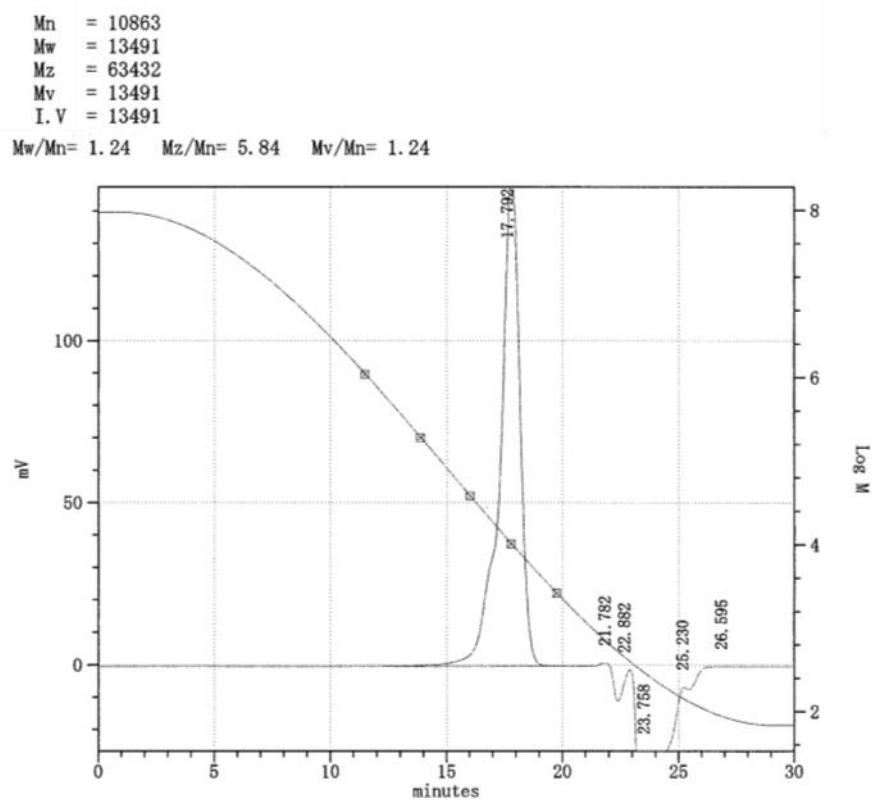


Figure S-28. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, Y-250-250 mixer, 30 degree-C)

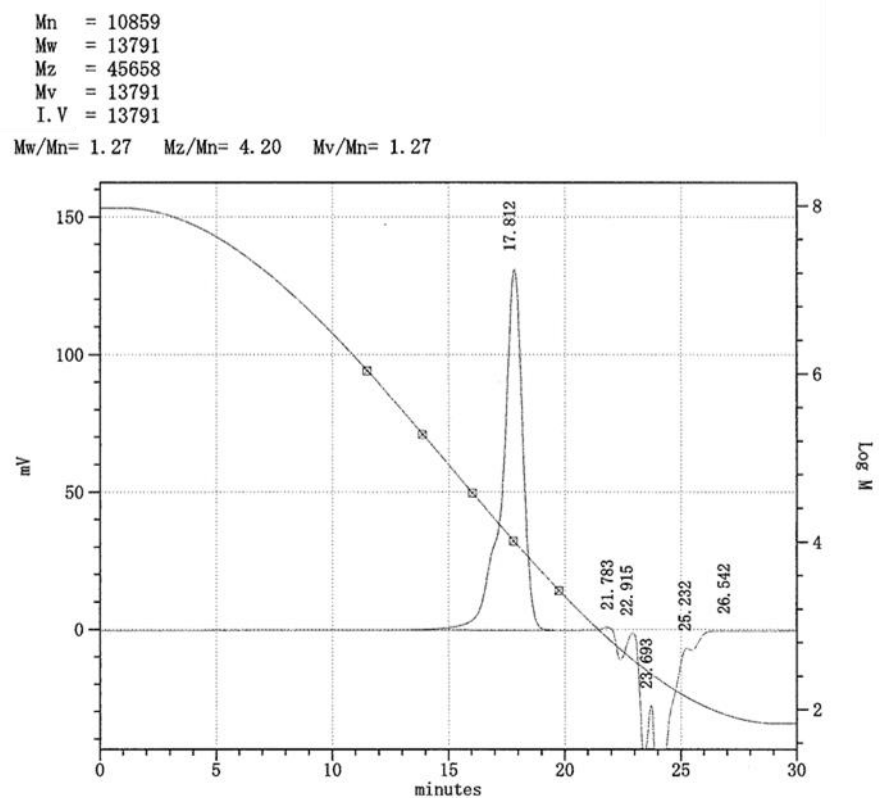


Figure S-29. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, Y-250-250 mixer, 30 degree-C)

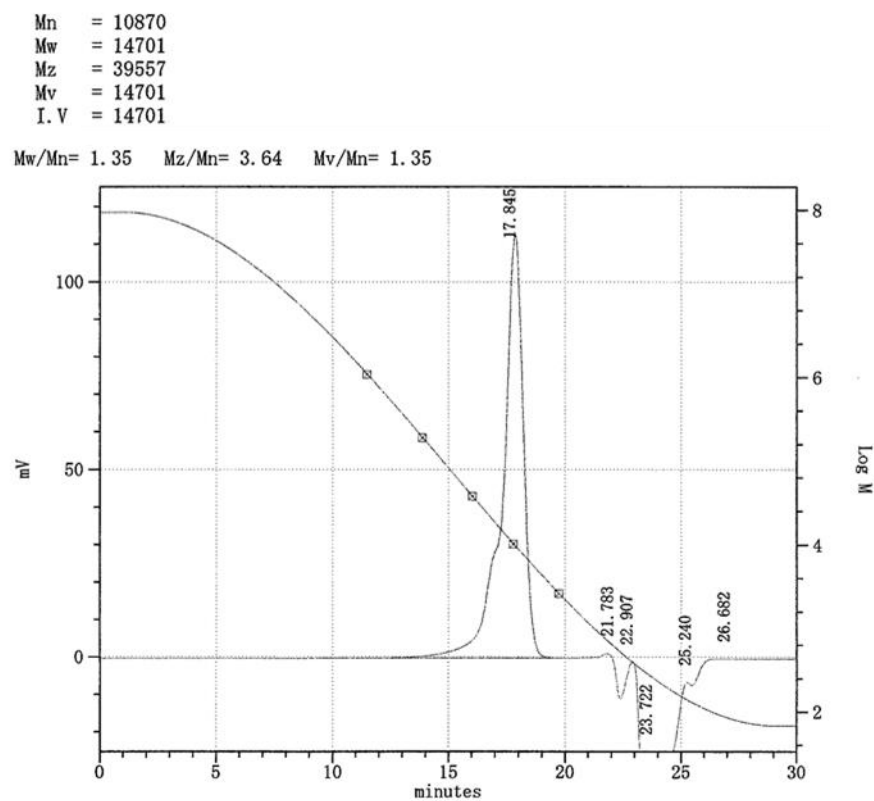


Figure S-30. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, Y-250-250 mixer, 30 degree-C)

Mn	= 11014
Mw	= 19194
Mz	= 283089
Mv	= 19194
I. V	= 19194

Mw/Mn= 1.74 Mz/Mn= 25.70 Mv/Mn= 1.74

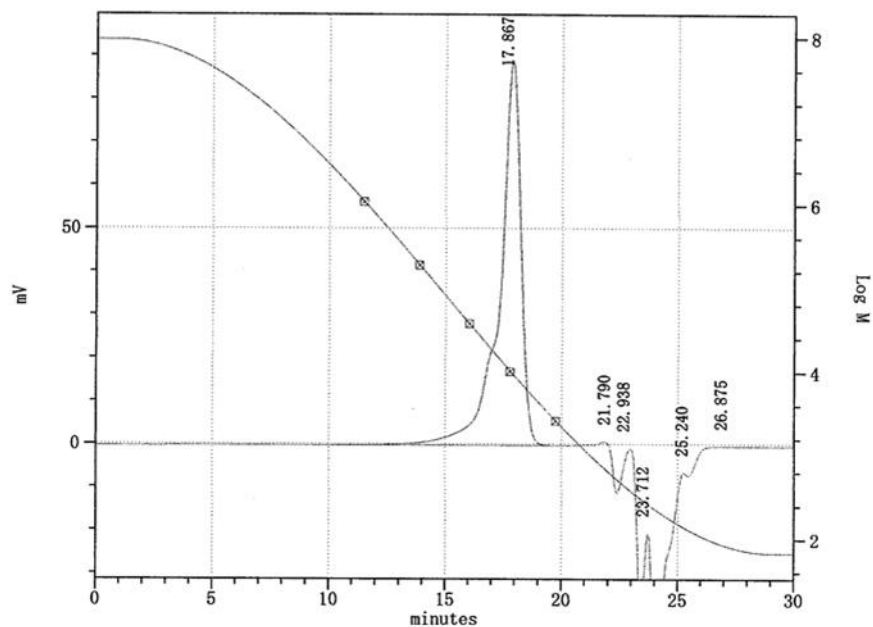


Figure S-31. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, Y-250-250 mixer, 30 degree-C)

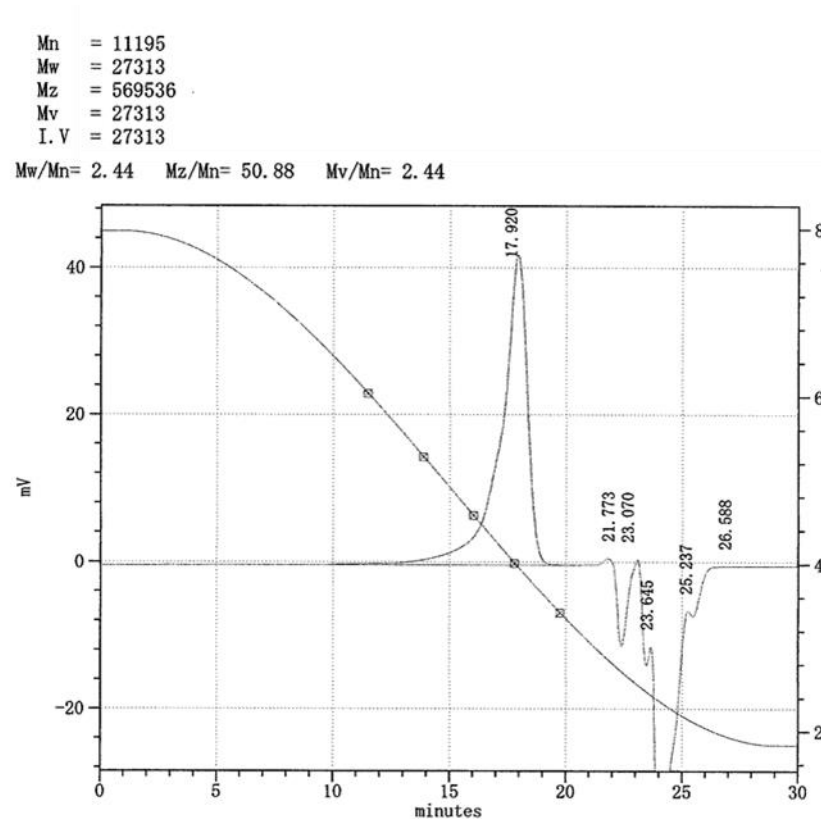


Figure S-32. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, Y-250-250 mixer, 30 degree-C)

$M_n = 9647$
 $M_w = 11287$
 $M_z = 14525$
 $M_v = 11287$
 $I.V. = 1.1287$

$M_w/M_n = 1.17$ $M_z/M_n = 1.51$ $M_v/M_n = 1.17$

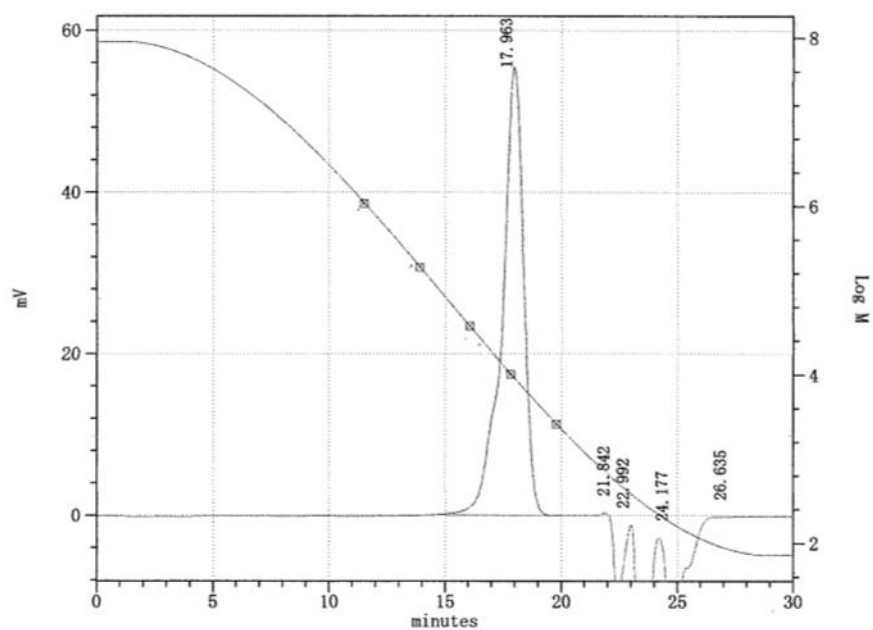


Figure S-33. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-500 mixer, 30 degree-C)

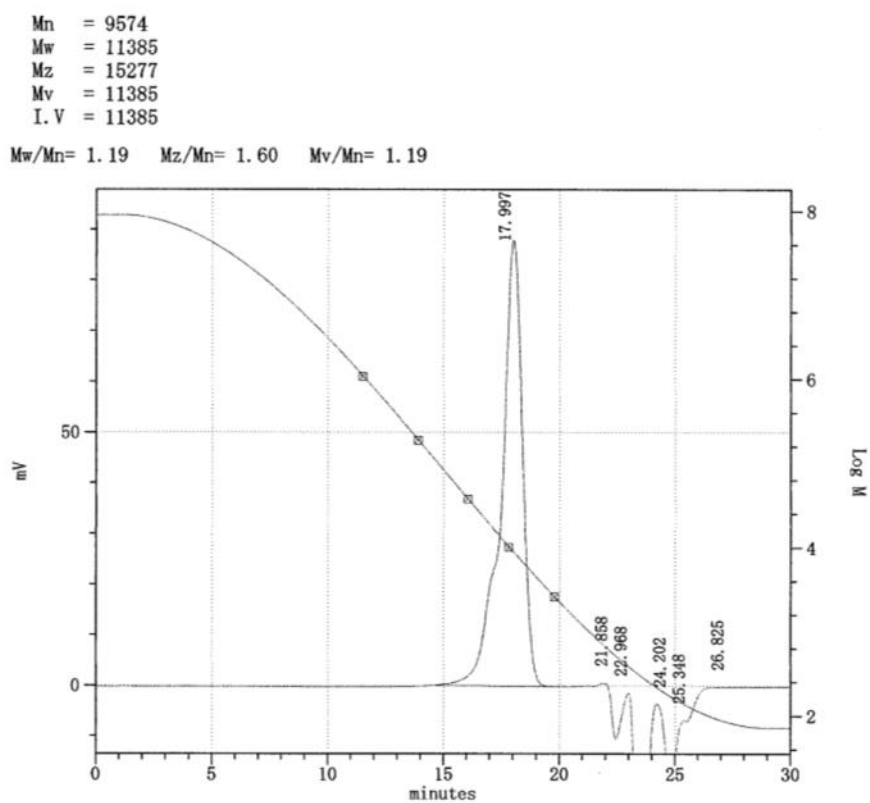


Figure S-34. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-500 mixer, 30 degree-C)

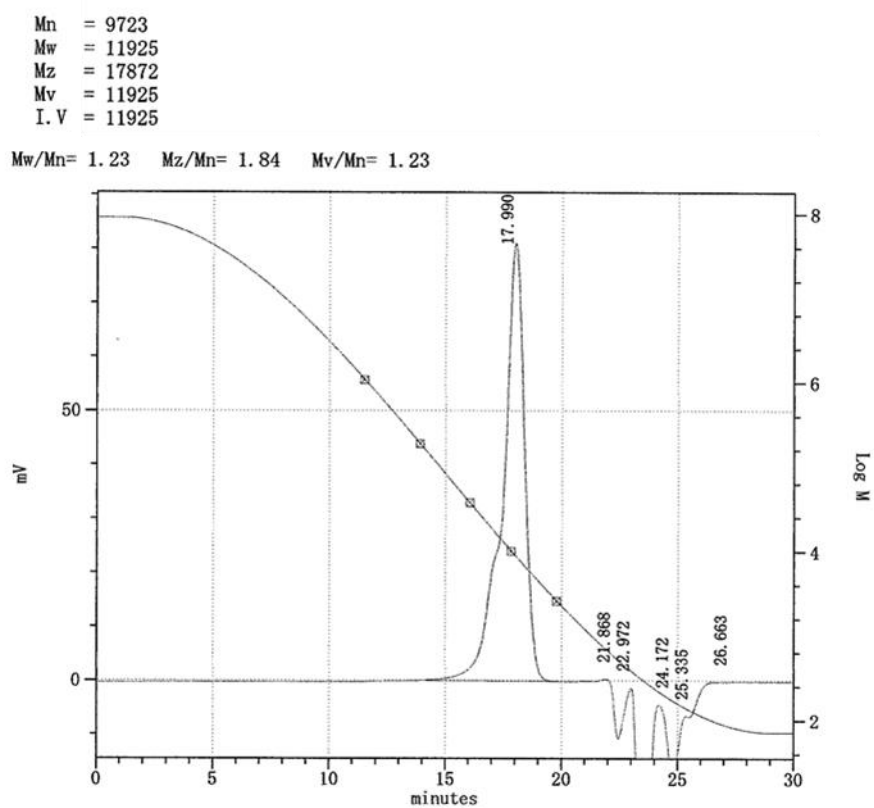


Figure S-35. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-500 mixer, 30 degree-C)

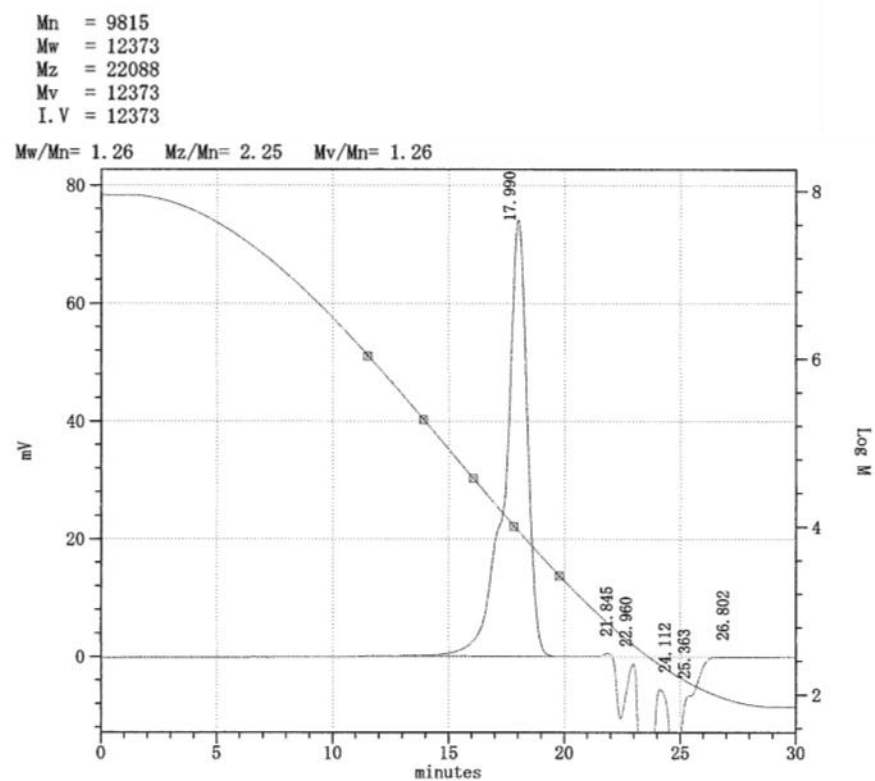


Figure S-36. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-500 mixer, 30 degree-C)

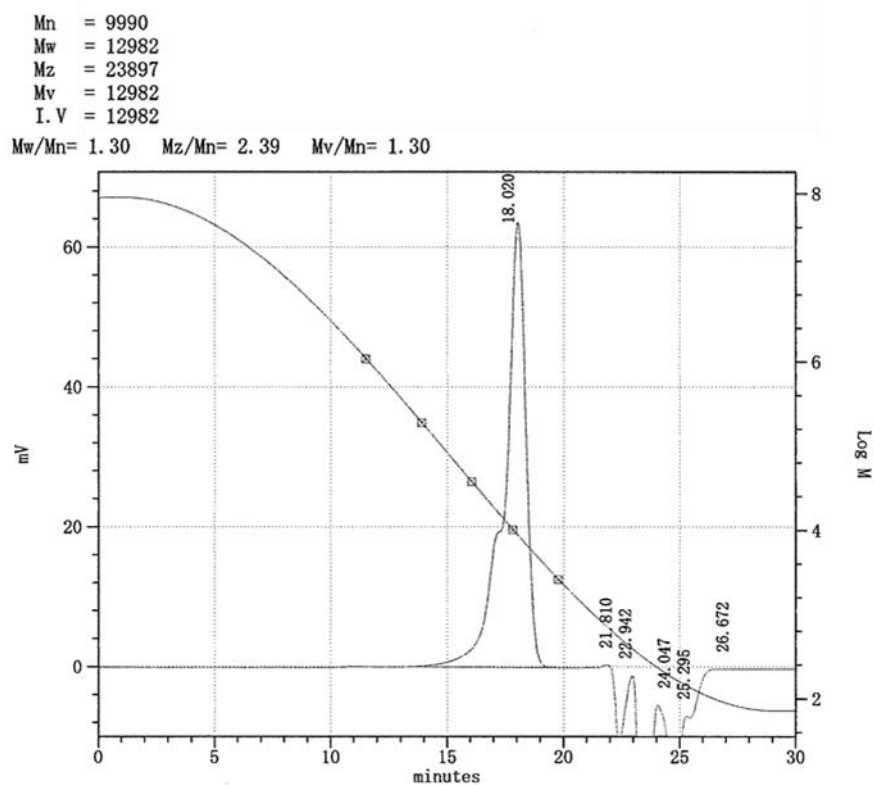


Figure S-37. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-500 mixer, 30 degree-C)

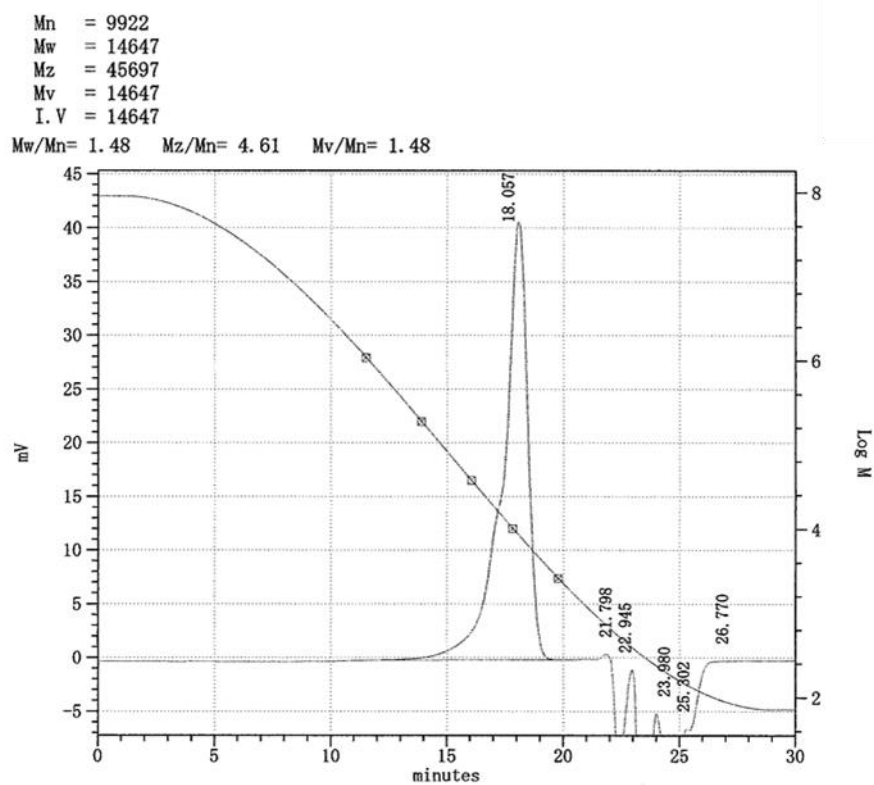


Figure S-38. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-250-500 mixer, 30 degree-C)

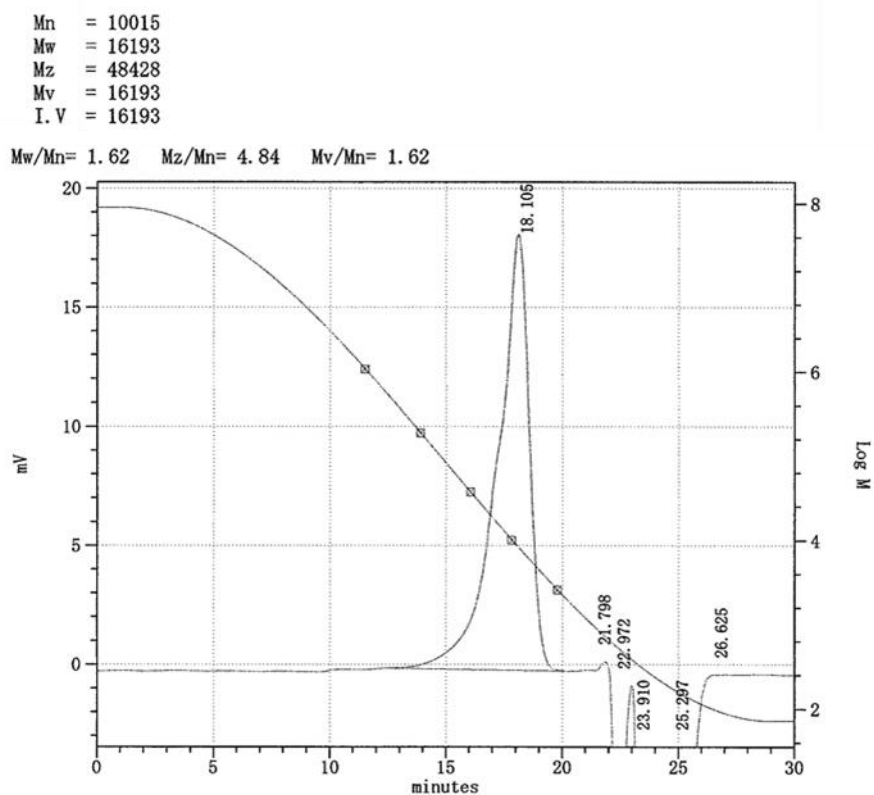


Figure S-39. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-250-500 mixer, 30 degree-C)

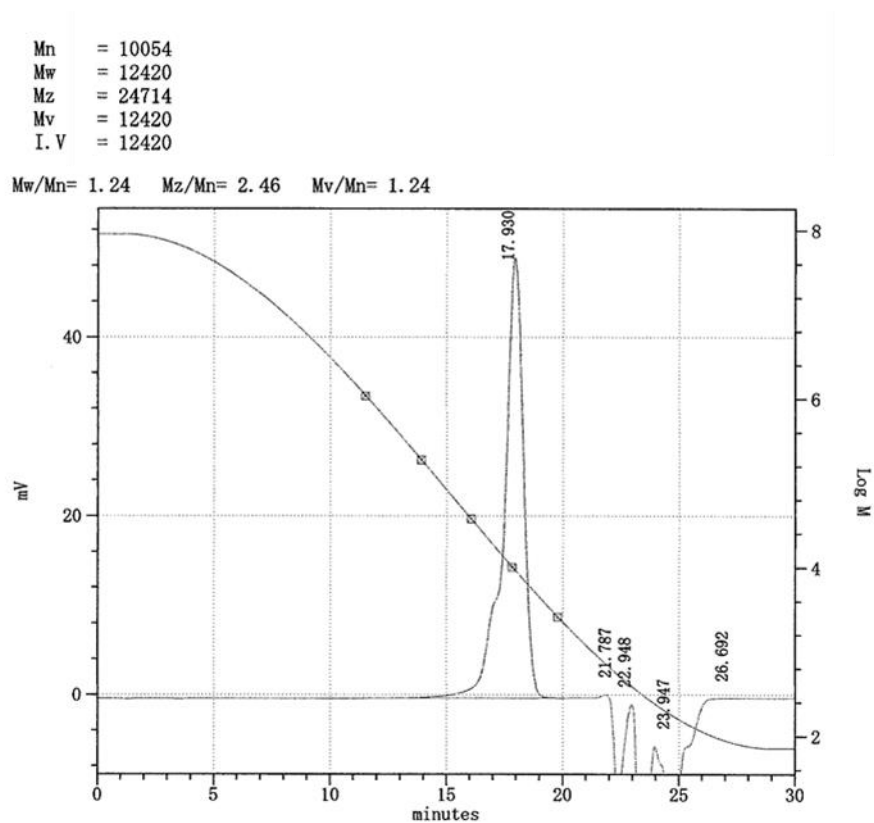


Figure S-40. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-500-250 mixer, 30 degree-C)

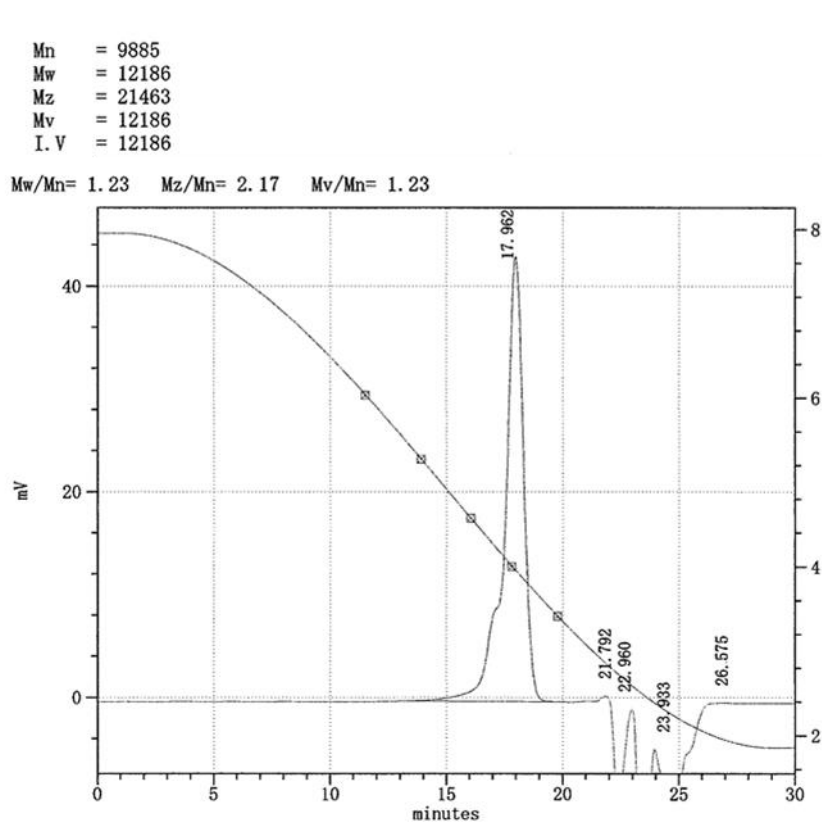


Figure S-41. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-500-250 mixer, 30 degree-C)

M_n = 9893
 M_w = 12584
 M_z = 26508
 M_v = 12584
 $I.V$ = 12584

M_w/M_n = 1.27 M_z/M_n = 2.68 M_v/M_n = 1.27

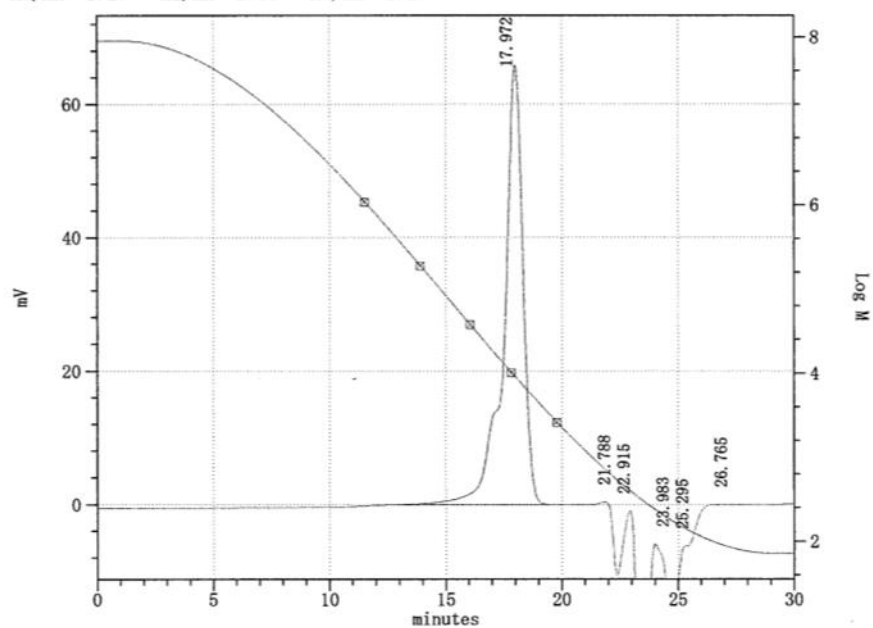


Figure S-42. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-500-250 mixer, 30 degree-C)

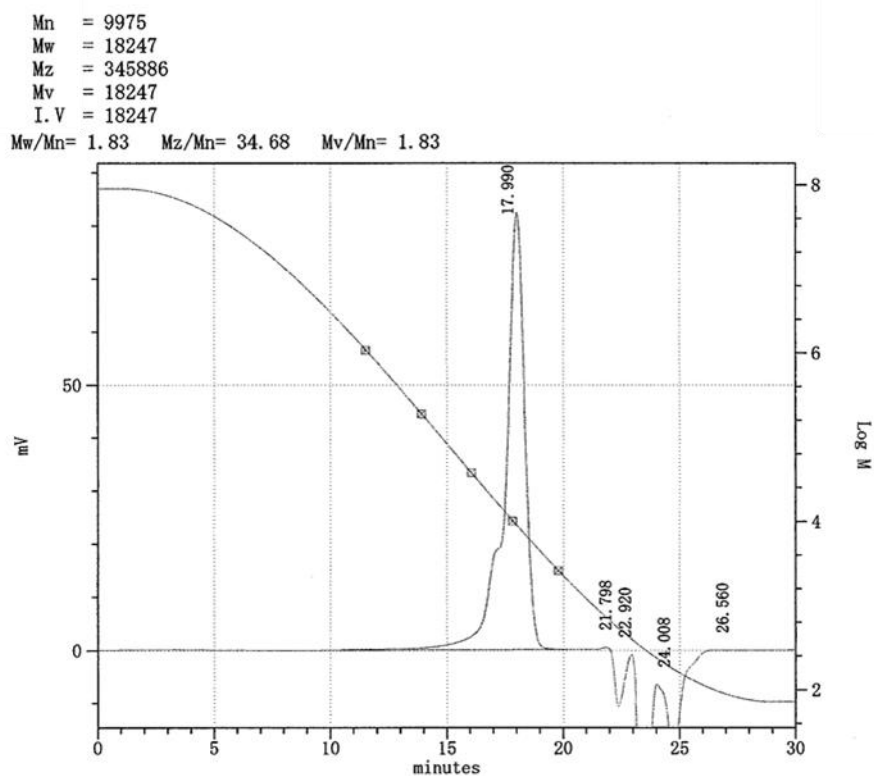


Figure S-43. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-500-250 mixer, 30 degree-C)

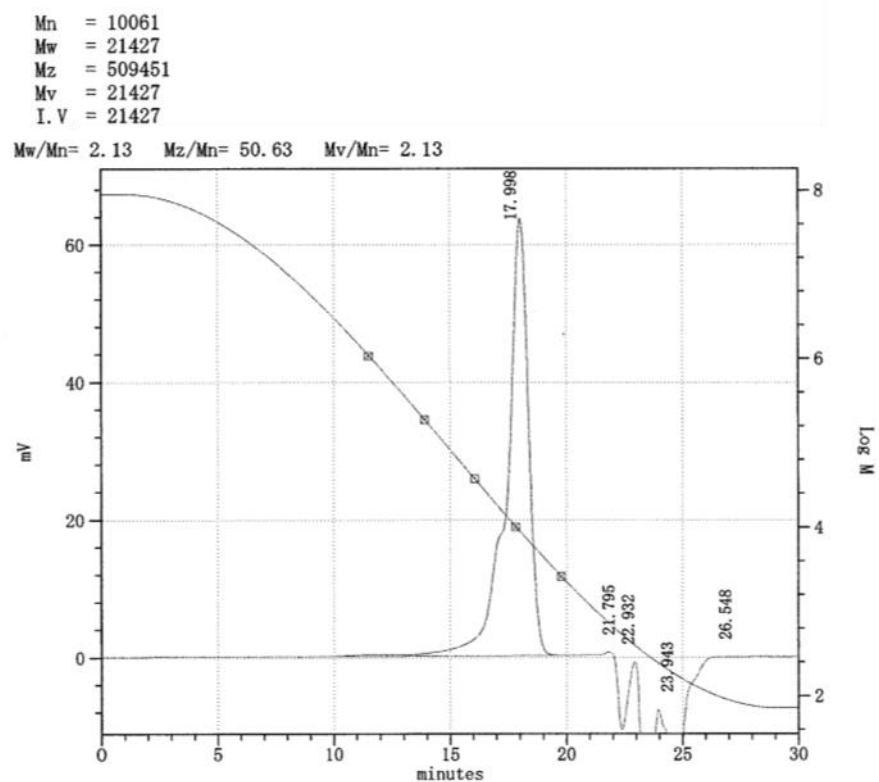


Figure S-44. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-500-250 mixer, 30 degree-C)

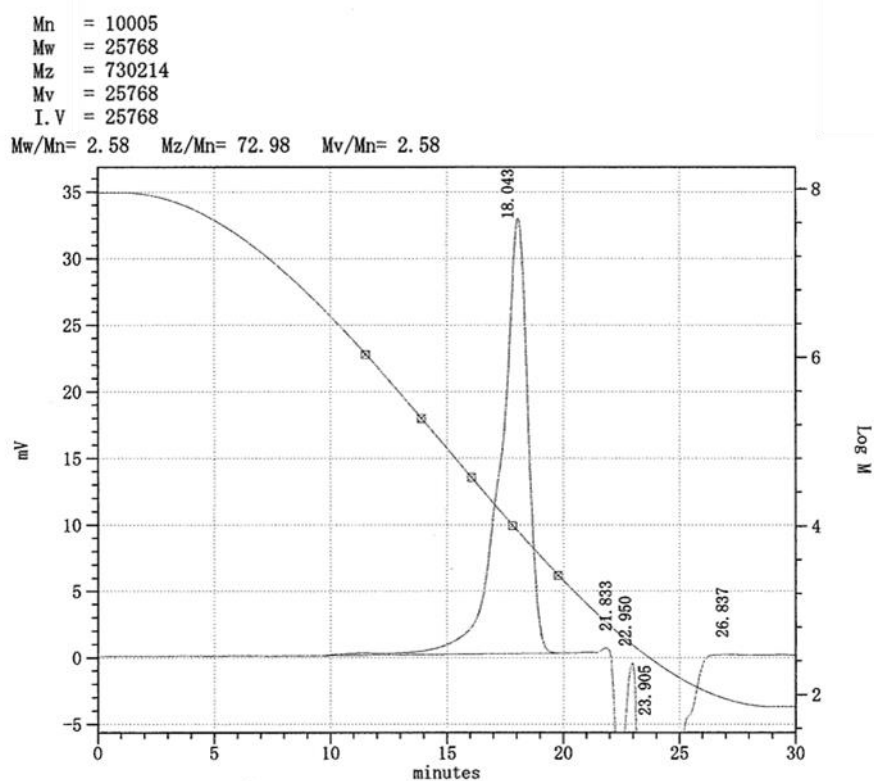


Figure S-45. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, T-500-250 mixer, 30 degree-C)

$M_n = 9896$
 $M_w = 35110$
 $M_z = 1045884$
 $M_v = 35110$
 $I.V. = 35110$

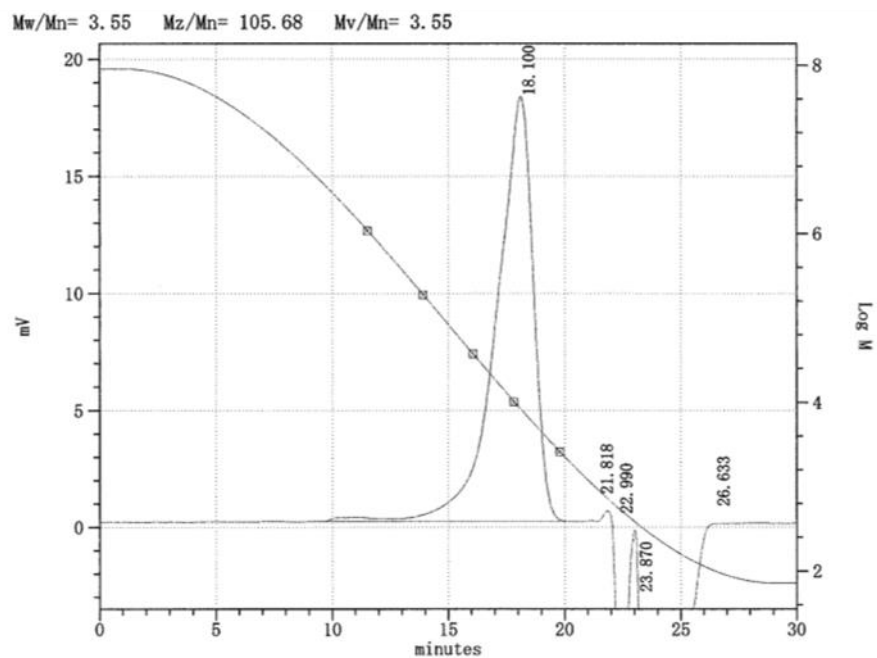


Figure S-46. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 0.5 mL/min, flow rate of Styrene (2.0 M) = 1.0 mL/min, T-500-250 mixer, 30 degree-C)

$M_n = 9919$
 $M_w = 11421$
 $M_z = 14306$
 $M_v = 11421$
 $I.V. = 11421$

$M_w/M_n = 1.15$ $M_z/M_n = 1.44$ $M_v/M_n = 1.15$

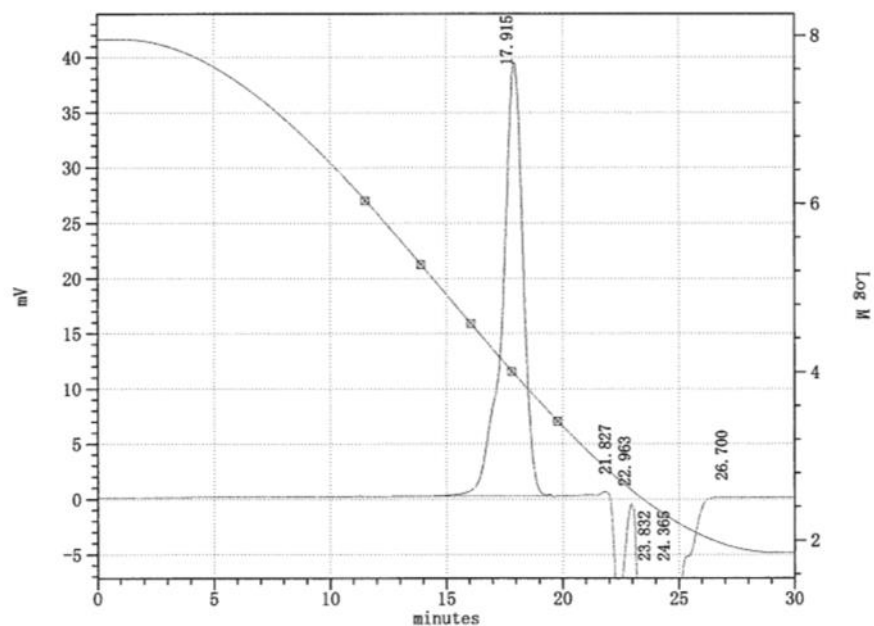


Figure S-47. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, V-500-500 mixer, 30 degree-C)

M_n = 9878
 M_w = 11484
 M_z = 14634
 M_v = 11484
 $I.V$ = 1.1484

M_w/M_n = 1.16 M_z/M_n = 1.48 M_v/M_n = 1.16

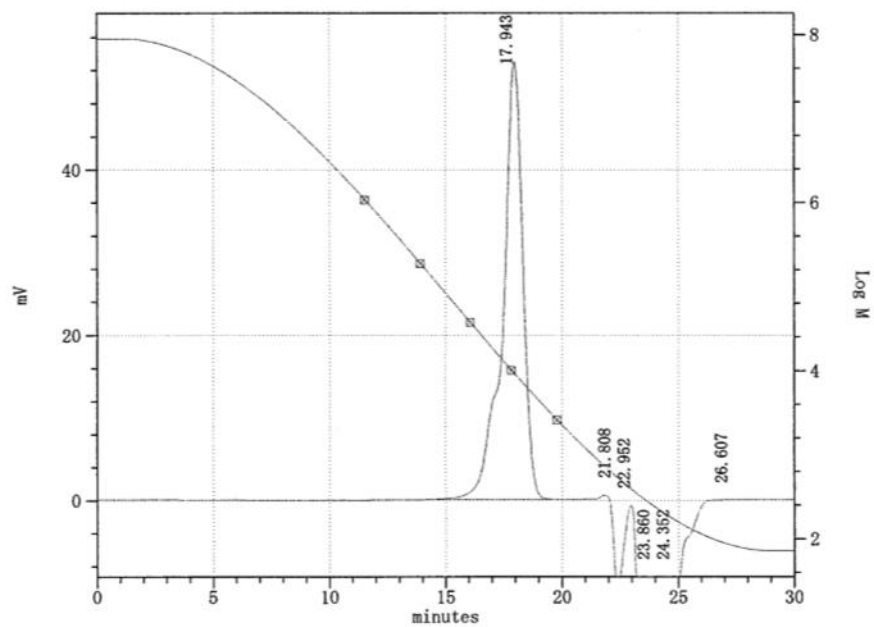


Figure S-48. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, V-500-500 mixer, 30 degree-C)

Mn	=	9958
Mw	=	11726
Mz	=	15426
Mv	=	11726
I. V	=	11726

Mw/Mn= 1.18 Mz/Mn= 1.55 Mv/Mn= 1.18

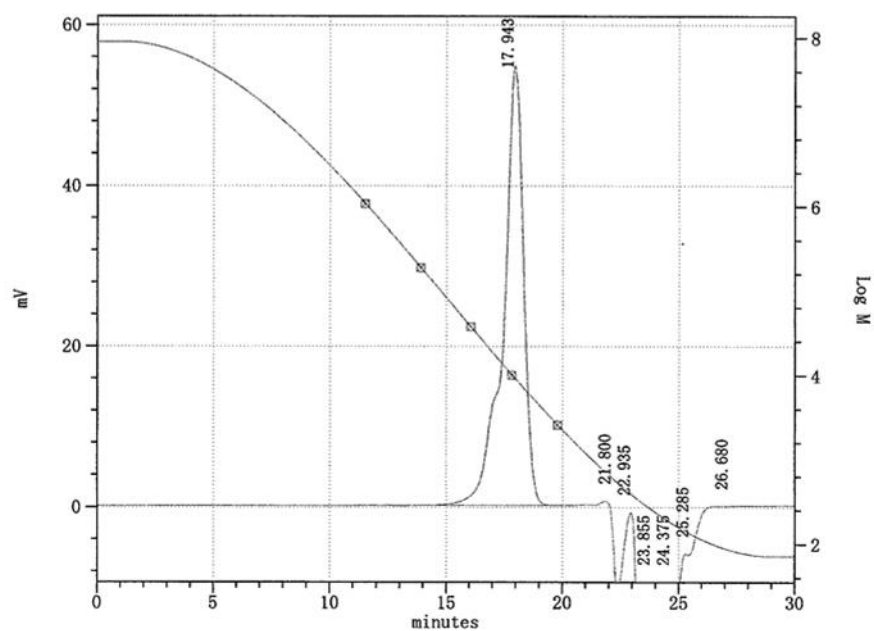


Figure S-49. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, V-500-500 mixer, 30 degree-C)

$M_n = 9906$
 $M_w = 11979$
 $M_z = 17364$
 $M_v = 11979$
 $I.V = 11979$

$M_w/M_n = 1.21$ $M_z/M_n = 1.75$ $M_v/M_n = 1.21$

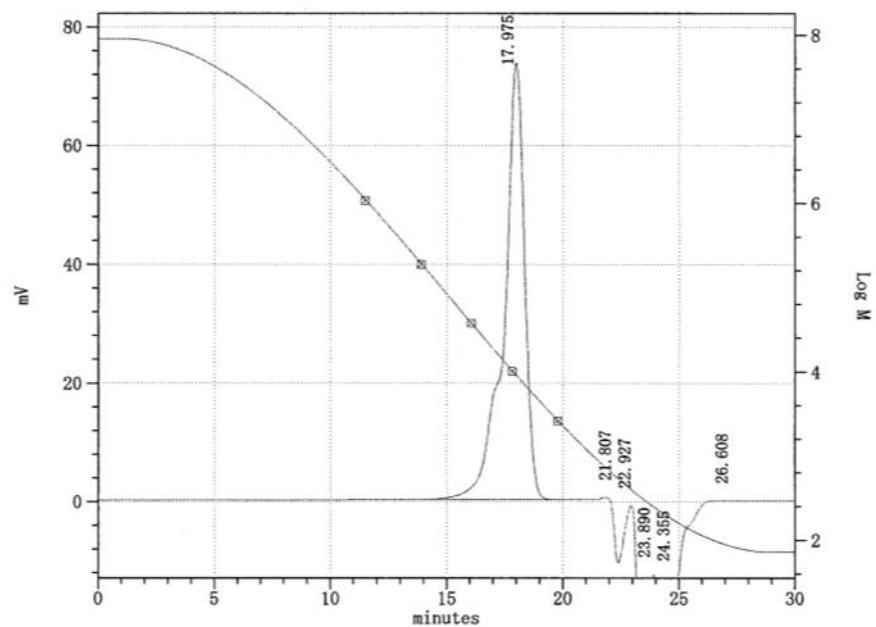


Figure S-50. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, V-500-500 mixer, 30 degree-C)

$M_n = 9908$
 $M_w = 12198$
 $M_z = 19420$
 $M_v = 12198$
 $I.V. = 12198$

$M_w/M_n = 1.23$ $M_z/M_n = 1.96$ $M_v/M_n = 1.23$

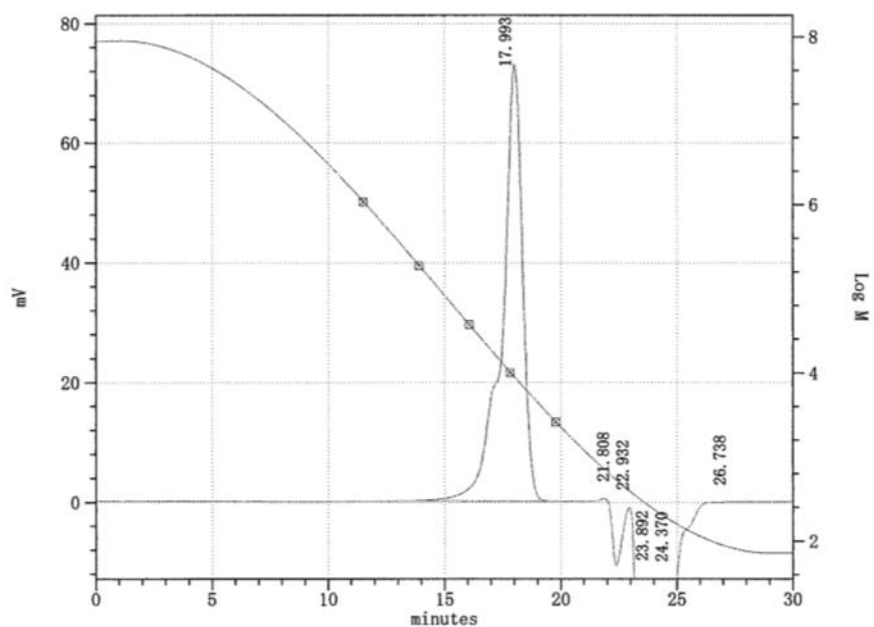


Figure S-51. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, V-500-500 mixer, 30 degree-C)

M_n = 10057
 M_w = 17629
 M_z = 245912
 M_v = 17629
 $I.V$ = 17629

M_w/M_n = 1.75 M_z/M_n = 24.45 M_v/M_n = 1.75

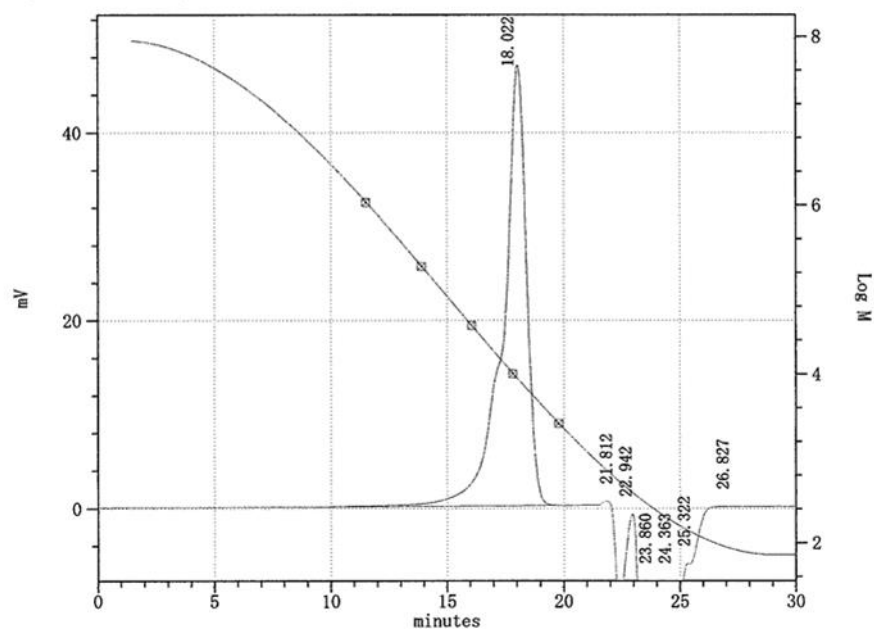


Figure S-52. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 1.0 mL/min, flow rate of Styrene (2.0 M) = 2.0 mL/min, V-500-500 mixer, 30 degree-C)

$M_n = 10241$
 $M_w = 11939$
 $M_z = 18510$
 $M_v = 11939$
 $I.V = 11939$
 $M_w/M_n = 1.17$ $M_z/M_n = 1.81$ $M_v/M_n = 1.17$

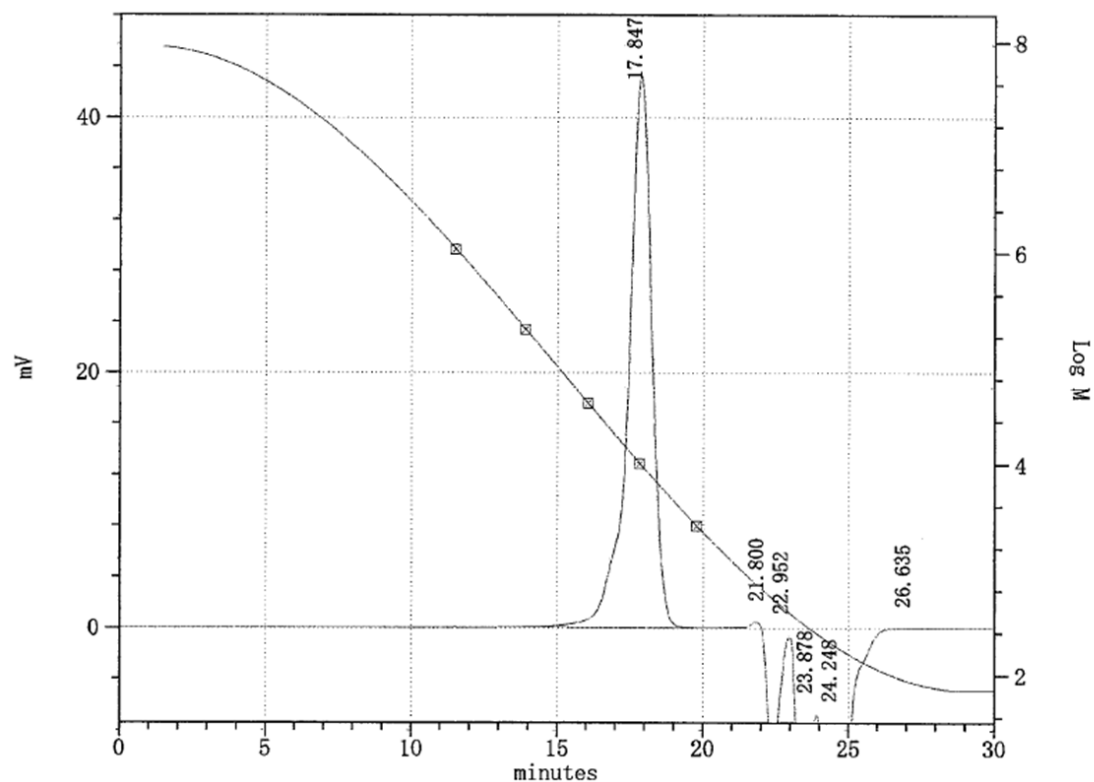


Figure S-53. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 7.5 mL/min, flow rate of Styrene (2.0 M) = 15.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

Mn = 10300

Mw = 12719

Mz = 33274

Mv = 12719

I. V = 12719

Mw/Mn = 1.23 Mz/Mn = 3.23 Mv/Mn = 1.23

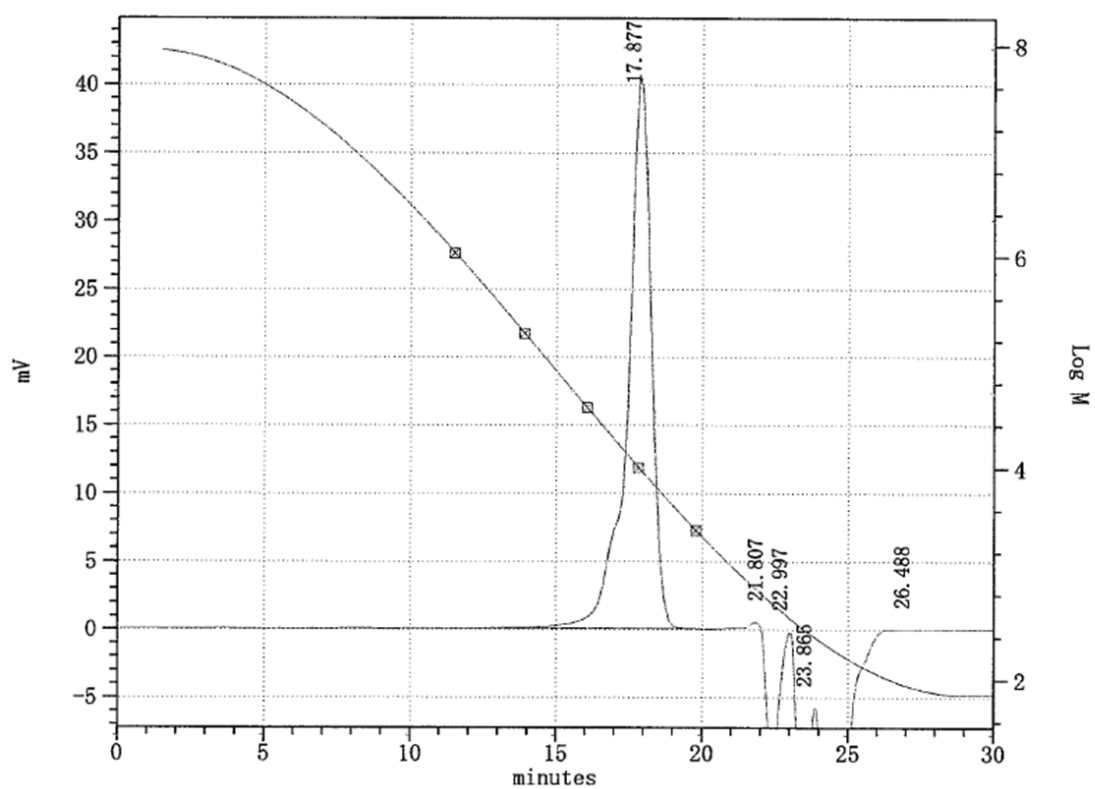


Figure S-54. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 5.0 mL/min, flow rate of Styrene (2.0 M) = 10.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

$M_n = 10242$
 $M_w = 12231$
 $M_z = 18472$
 $M_v = 12231$
 $I.V = 12231$

$M_w/M_n = 1.19$ $M_z/M_n = 1.80$ $M_v/M_n = 1.19$

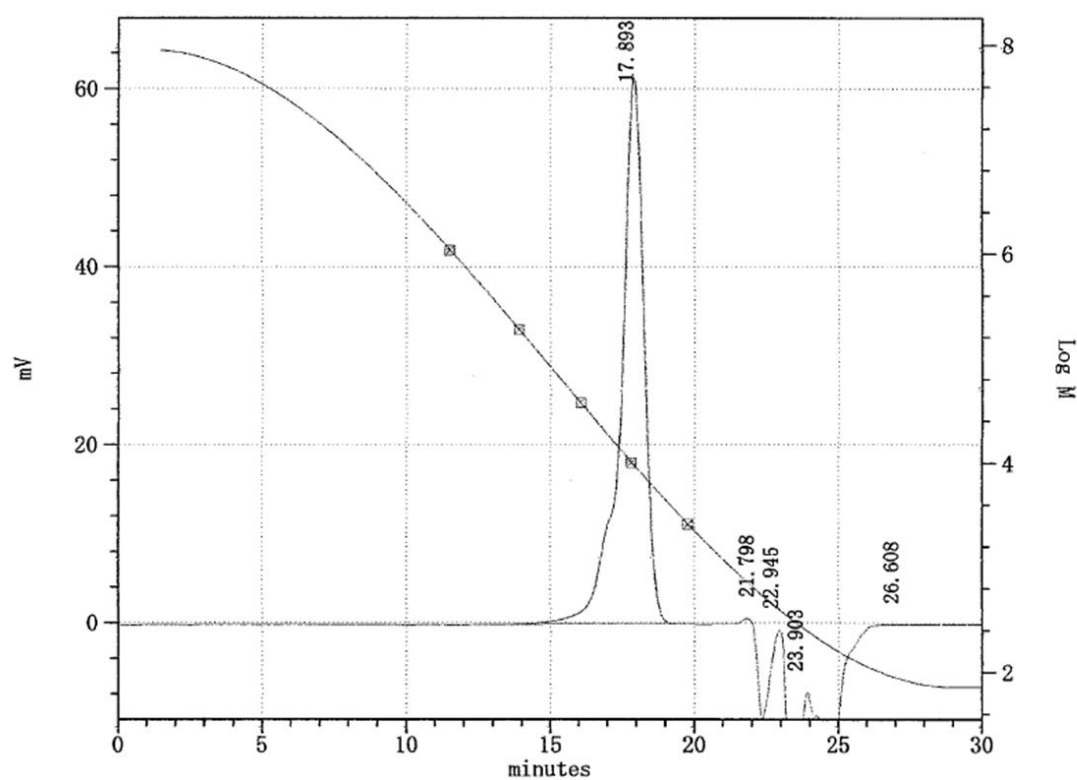


Figure S-55. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 4.0 mL/min, flow rate of Styrene (2.0 M) = 8.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

Mn = 10411

Mw = 13004

Mz = 23095

Mv = 13004

I. V = 13004

Mw/Mn= 1.25 Mz/Mn= 2.22 Mv/Mn= 1.25

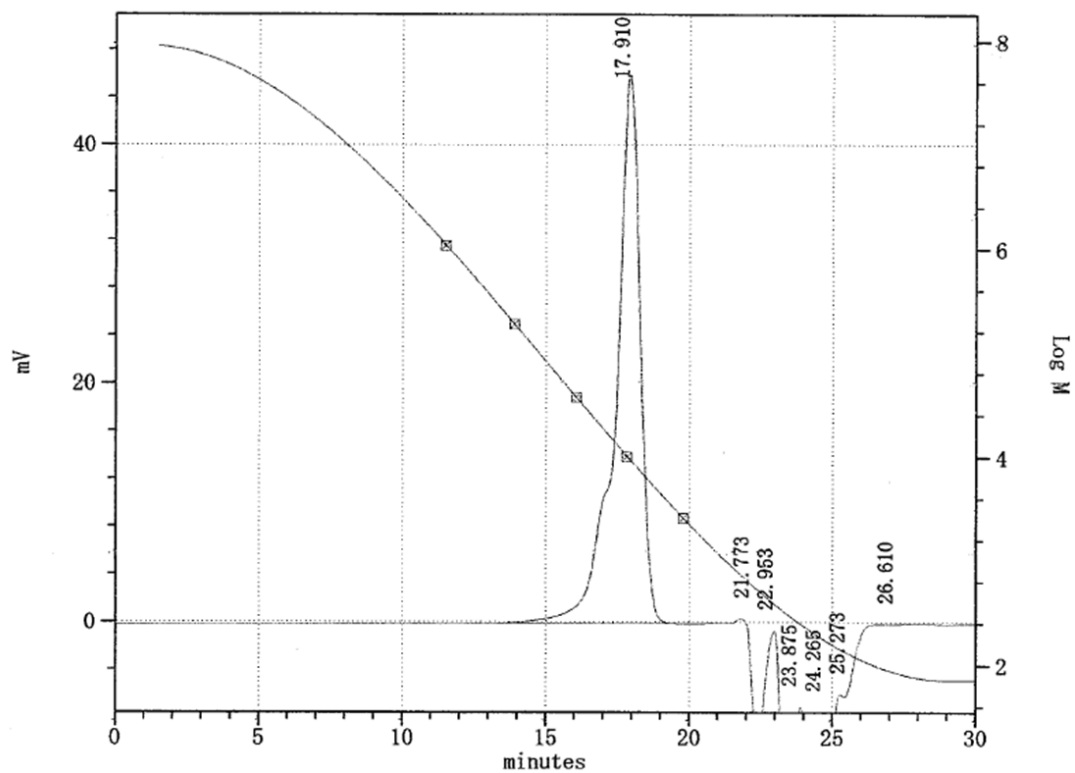


Figure S-56. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 3.0 mL/min, flow rate of Styrene (2.0 M) = 6.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

$M_n = 10465$

$M_w = 13451$

$M_z = 26132$

$M_v = 13451$

$I.V = 13451$

$M_w/M_n = 1.29$ $M_z/M_n = 2.50$ $M_v/M_n = 1.29$

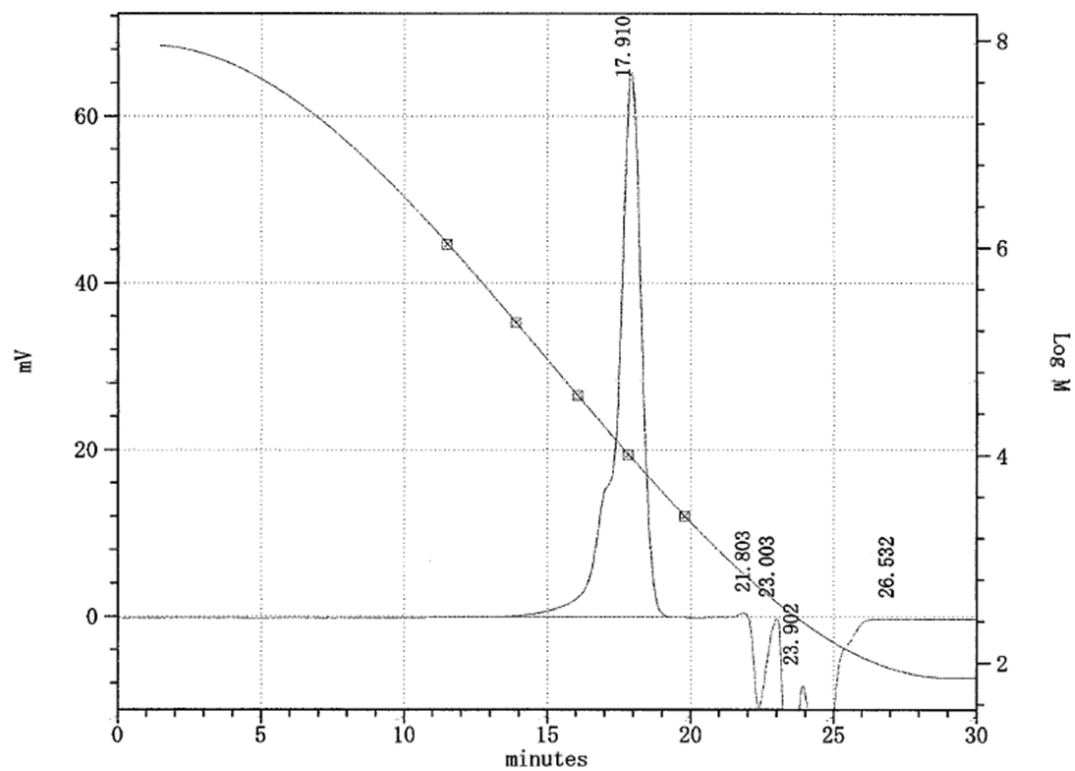


Figure S-57. *n*-BuLi Initiated Polymerization of Styrene in The Flow System (flow rate of *n*-BuLi (0.05 M) = 2.0 mL/min, flow rate of Styrene (2.0 M) = 4.0 mL/min, T-250-250 mixer, 30 degree-C, 2nd trial)

The reproducibility of anionic polymerization

2nd trial of anionic polymerization was conducted with T-250-250 mixer at 30 degree-C in some flow rate conditions to evaluate the reproducibility. The results of 2nd trial was similar to it of 1st trial which was described in the manuscript. Figure S-58 shows these results.

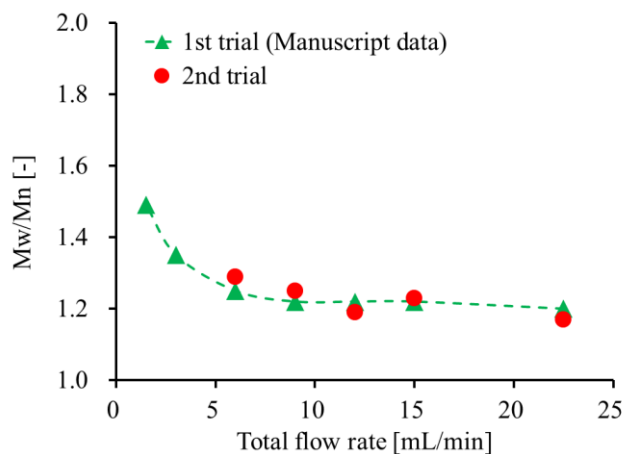


Figure S-58. Comparing the Mw/Mn of 1st and 2nd trials

Table S-1. Numeric data of 2nd trial in the above graph

Mixer shape	T (°C)	Flow rate (mL/min)			Mn	Mw/Mn
		<i>n</i> -BuLi	Styrene	[M]/[I]		
T-250-250	30	7.5	15.0	80	10000	1.17
		5.0	10.0	80	10000	1.23
		4.0	8.0	80	10000	1.19
		3.0	6.0	80	10000	1.25
		2.0	4.0	80	10000	1.29

Explaining the results of Dushman reaction

What the mixability of three mixers was $V \cong T > Y$ in terms of Mw/Mn in this study.

On the other hand, figure S-59 and S-60 show results of Dushman reaction. In the result, mixability order of Dushman reaction was also $V > T > Y$.

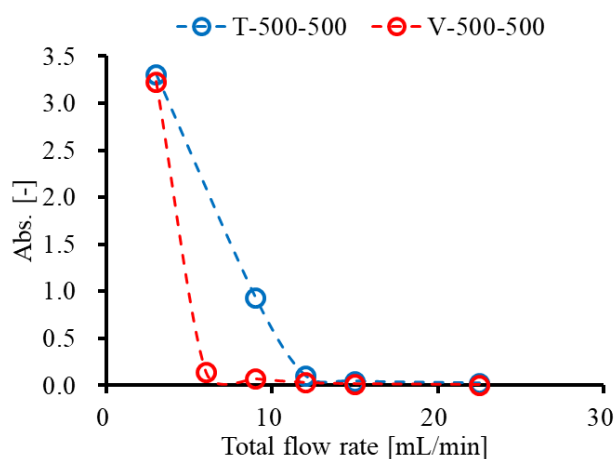


Figure S-59. Comparing V-shape and T- shape mixers in Dushman reaction

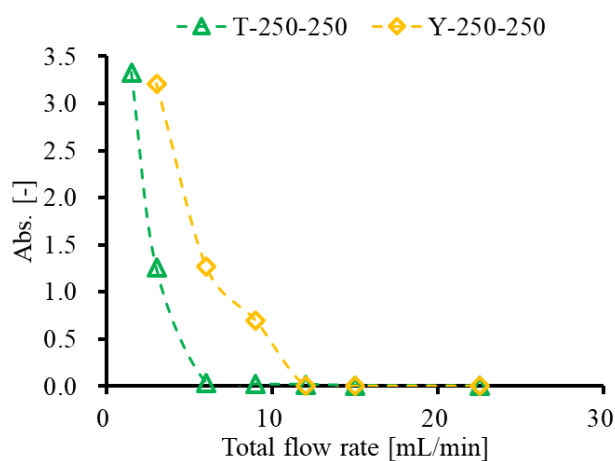


Figure S-60. Comparing Y-shape and T- shape mixers in Dushman reaction

Table S-2. Numeric data of each graph in Dushman reaction

Flow rate (mL/min)		Absorbance [352 nm] (-)			
Solution A	Solution B	T-250-250	T-500-500	V-500-500	Y-250-250
0.75	0.75	3.33	3.43	3.37	3.34
1.50	1.50	1.26	3.31	3.23	3.21
3.00	3.00	0.04	3.23	0.14	1.27
4.50	4.50	0.02	0.93	0.07	0.70
6.00	6.00	0.02	0.10	0.03	0.01
7.50	7.50	0.01	0.05	0.02	0.00
11.25	11.25	0.00	0.03	0.01	0.00