Electronic Supplementary Material (ESI) for Nanoscale.
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# Electronic Supplementary Information (ESI)

**Rapid template free synthesis of nanostructured conducting polymer film by tuning morphology using hyperbranched polymer additive**

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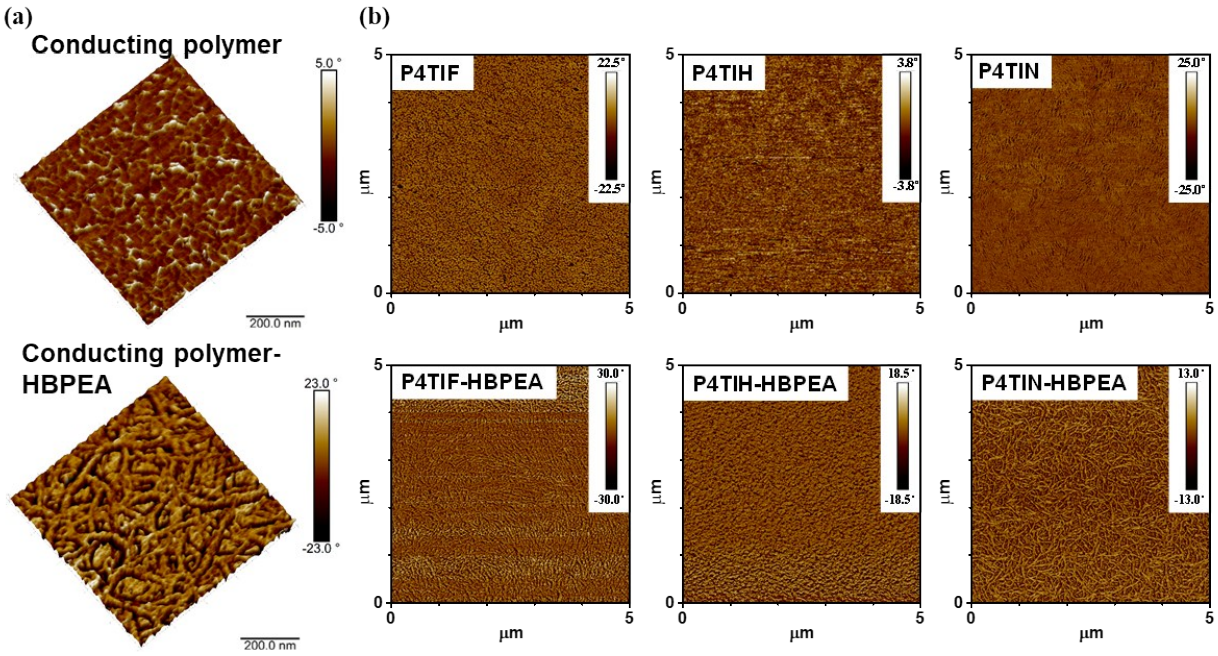


**Figure S1.** (a) AFM phase images of polymer film and conducting polymer-HBPEA film. (b) AFM phase images of neat polymer film (P4TIF, P4TIH and P4TIN) and CP-HBPEA film (P4TIF-HBPEA, P4TIH-HBPEA and P4TIN-HBPEA).

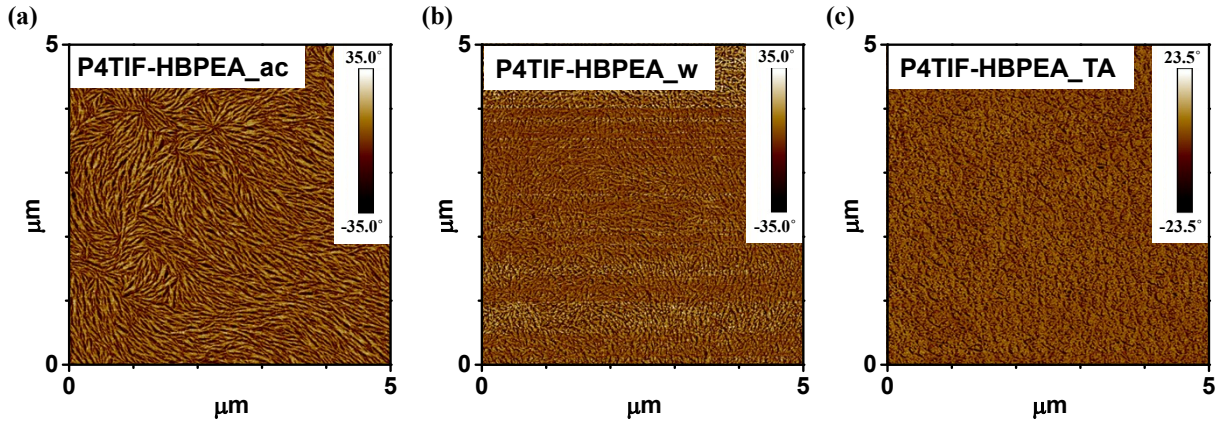


**Figure S2.** AFM phase images of a) P4TIF–HBPEA_ac; b) P4TIF–HBPEA_w and c) P4TIF–HBPEA_TA.

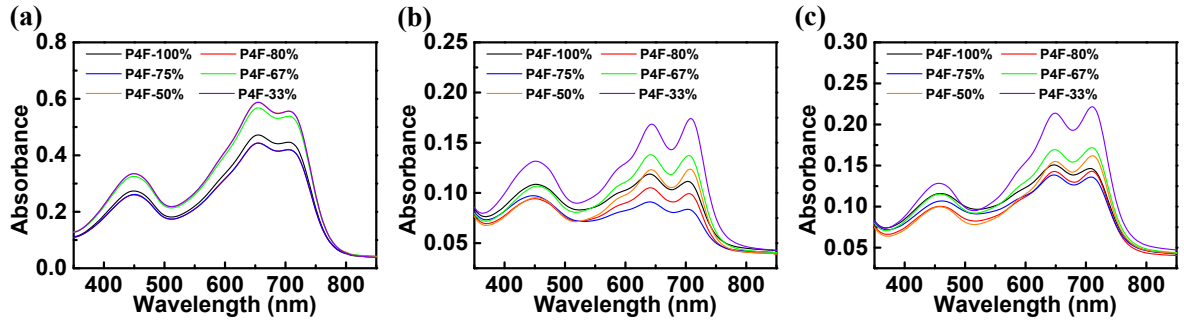


**Figure S3.** The UV-vis spectra of (a) P4TIF-HBPEA chloroform solution; (b) P4TIF-HBPEA_ac films and (c) P4TIF-HBPEA_TA films.

**Table S1.** Vibrational peaks of P4TIF in P4TIF-HBPEA blends characterized by UV-vis absorption spectra.

| Sample | Solution | | As-cast film | | Thermal annealed film | |
|---|---|---|---|---|---|---|
| | $\lambda_{0\text{-}0}$ [nm] | $\lambda_{0\text{-}1}$ [nm] | $\lambda_{0\text{-}0}$ [nm] | $\lambda_{0\text{-}1}$ [nm] | $\lambda_{0\text{-}0}$ [nm] | $\lambda_{0\text{-}1}$ [nm] |
| P4F-100% | 705 | 655 | 707 | 648 | 703 | 640 |
| P4F-80% | 705 | 655 | 710 | 648 | 705 | 642 |
| P4F-75% | 705 | 655 | 710 | 648 | 703 | 641 |
| P4F-67% | 705 | 655 | 710 | 649 | 705 | 642 |
| P4F-50% | 705 | 655 | 710 | 649 | 707 | 643 |
| P4F-33% | 705 | 655 | 710 | 649 | 708 | 643 |

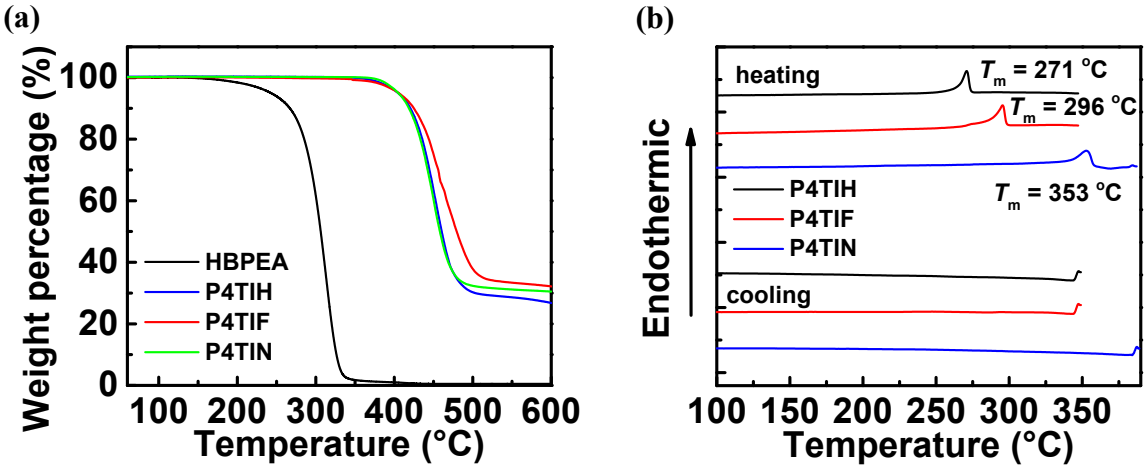


**Figure S4. (a)** TGA thermograms of HBPEA, P4TIH, P4TIF and P4TIN**; (b)** DSC thermograms of P4TIH, P4TIF and P4TIN.

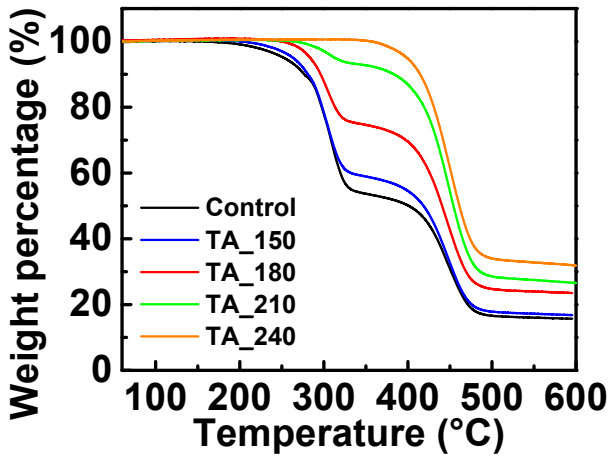


**Figure S5.** TGA thermograms of P4TIF-HBPEA bulk materials with thermal treatment at 150, 180, 210 and 240˚C.

**Table S2.** P4TIF content in P4TIF-HBPEA bulk materials with thermal treatment at 150, 180, 210 and 240˚C.

| Sample | P4TIF content [wt%][a)] |
|---|---|
| Control | 53.6 |
| TA_150 | 58.8 |
| TA_180 | 74.5 |
| TA_210 | 92.7 |
| TA_240 | 100 |

[a)] The composition of P4TIF is determined by TGA

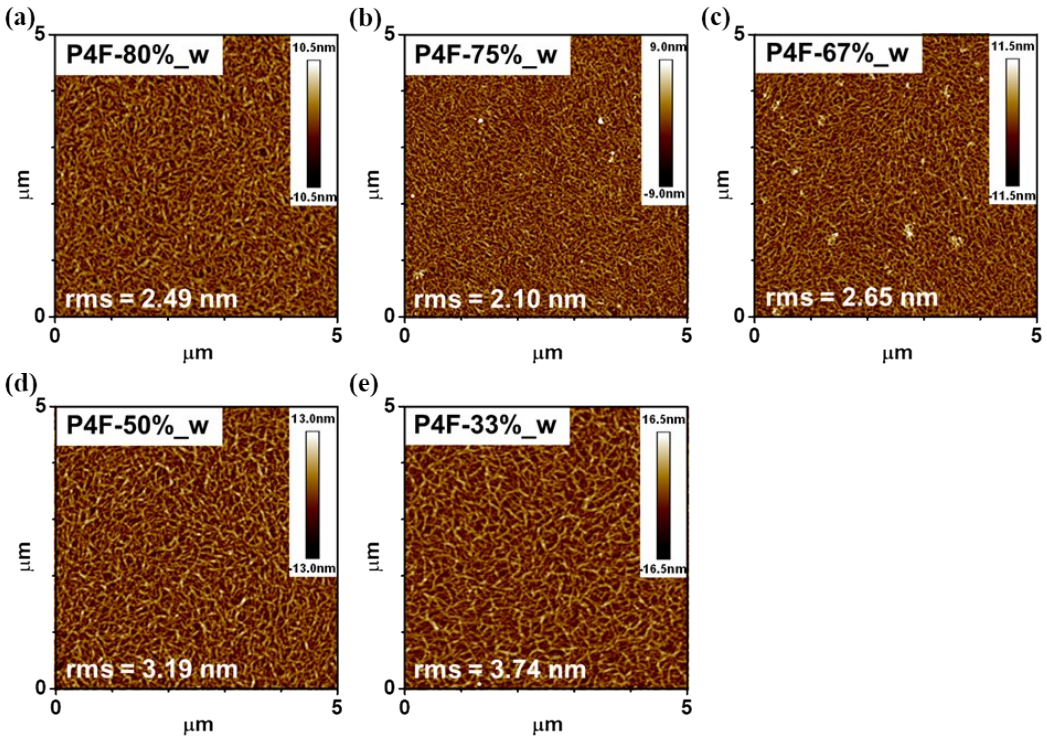


**Figure S6.** The AFM topographic images of (a) P4F-80%_w, (b) P4F-75%_w, (c) P4F-67%_w, (d) P4F-50%_w and (e) P4F-33%_w.

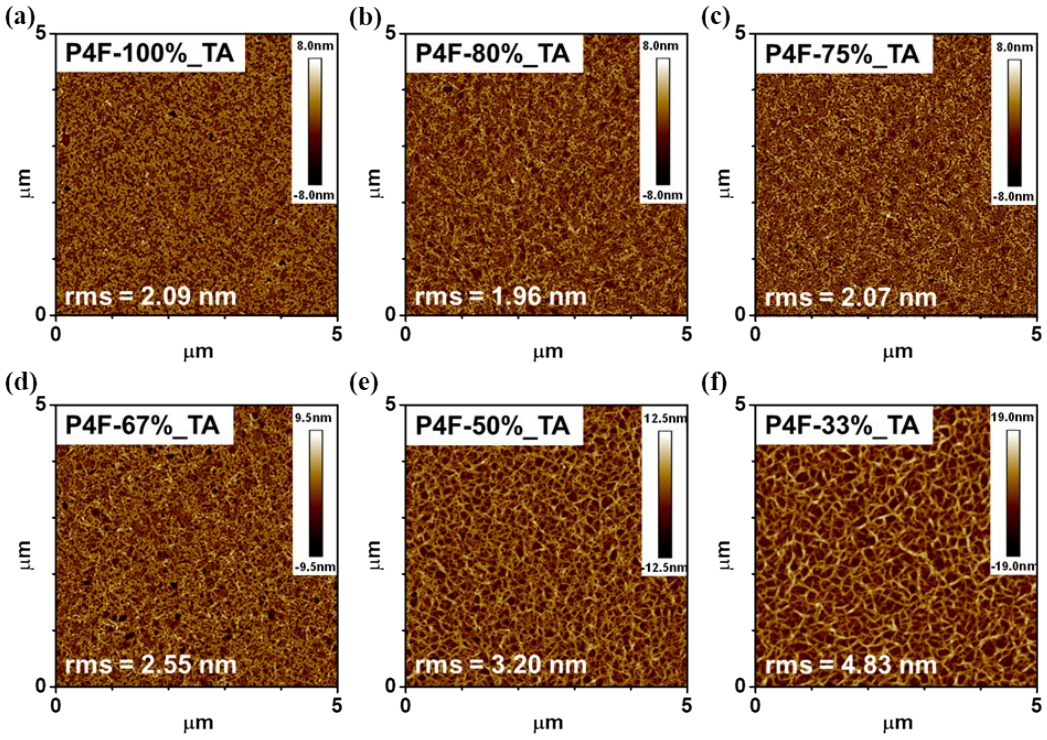


**Figure S7.** The AFM topographic images of (a) P4F-100%_TA, (b) P4F-80%_TA, (c) P4F-75%_TA, (d) P4F-67%_TA, (e) P4F-50%_TA and (f) P4F-33%_TA.

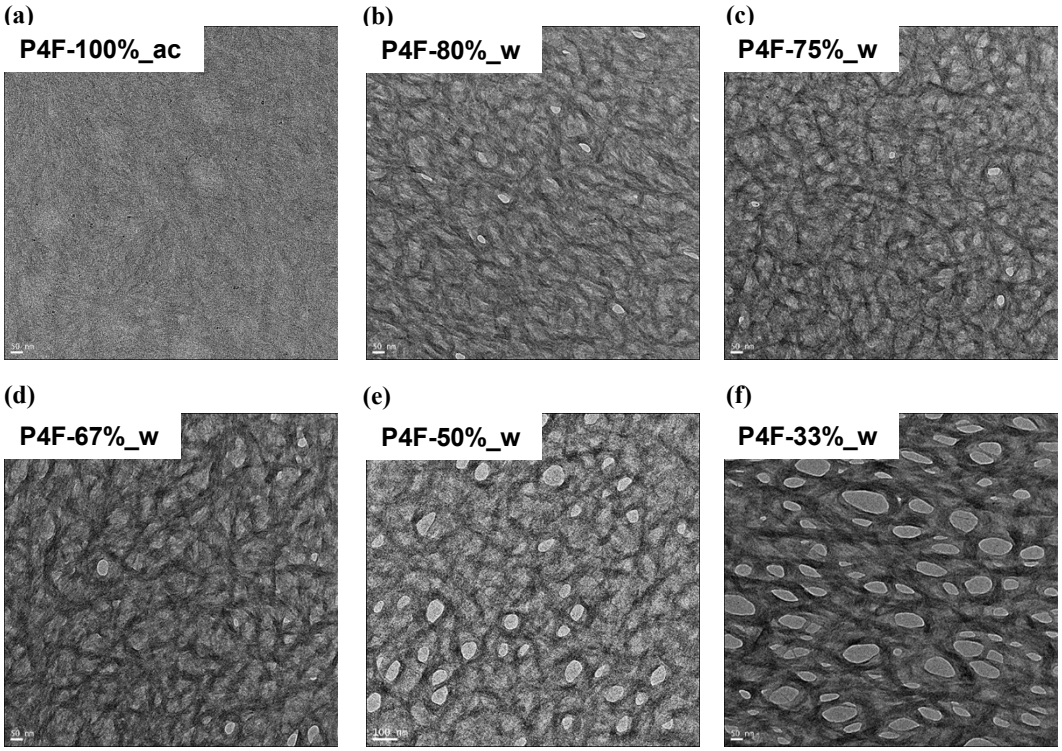


**Figure S8.** The TEM images of (a) P4F-100%_ac, (b) P4F-80%_w, (c) P4F-75%_w, (d) P4F-67%_w, (e) P4F-50%_w and (f) P4F-33%_w.

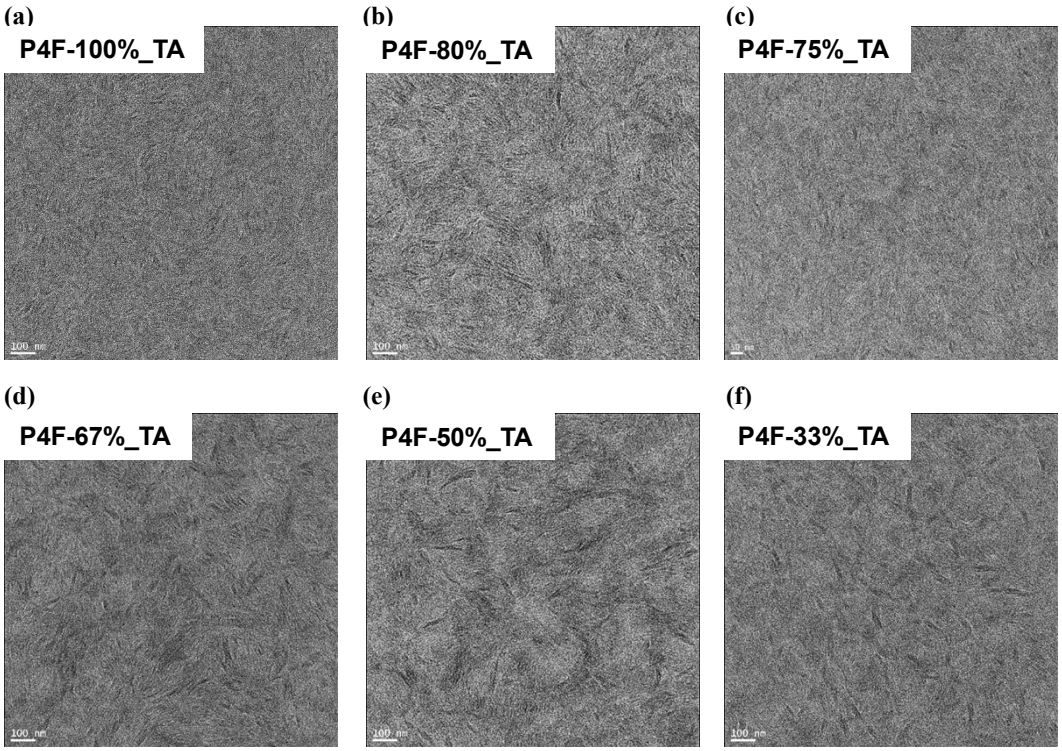


**Figure S9.** The TEM images of (a) P4F-100%_TA, (b) P4F-80%_TA, (c) P4F-75%_TA, (d) P4F-67%_TA, (e) P4F-50%_TA and (f) P4F-33%_TA.

**Table S3.** Electrical properties of neat P4TIX films after thermal annealing.

| Sample | $\mu_{sat}$ [$cm^2V^{-1}s^{-1}$] | on/off | $V_T$ [V] |
|---|---|---|---|
| P4TIF | 0.34 ± 0.033 | > $10^4$ | -10.3 ± 2.0 |
| P4TIH | 0.20 ± 0.011 | > $10^4$ | -6.8 ± 1.1 |
| P4TIN | 0.18 ± 0.005 | > $10^4$ | -18.9 ± 4.1 |

**Table S4.** Electrical properties of P4TIF-HV_TA films.

| Sample | $\mu_{sat}$ [$cm^2V^{-1}s^{-1}$] | on/off | $V_T$ [V] |
|---|---|---|---|
| P4F-100%_TA | 0.34 ± 0.033 | > $10^4$ | -10.3 ± 2.0 |
| P4F-80%_TA | 0.32 ± 0.049 | > $10^4$ | -14.3 ± 1.8 |
| P4F-75%_TA | 0.30 ± 0.064 | > $10^4$ | -10.3 ± 0.8 |
| P4F-67%_TA | 0.32 ± 0.053 | > $10^4$ | -10.0 ± 1.2 |
| P4F-50%_TA | 0.39 ± 0.050 | > $10^4$ | -14.0 ± 2.7 |
| P4F-33%_TA | 0.19 ± 0.043 | > $10^3$ | -14.6 ± 1.7 |

**Table S5.** Electrical properties of P4TIF-HV_w films.

| Sample | $\mu_{sat}$ [$cm^2V^{-1}s^{-1}$] | on/off | $V_T$ [V] |
|---|---|---|---|
| P4F-80%_w | 0.052 ± 0.003 | > $10^3$ | -8.0 ± 1.0 |
| P4F-75%_w | 0.052 ± 0.001 | > $10^3$ | -5.6 ± 0.2 |
| P4F-67%_w | 0.053 ± 0.002 | > $10^3$ | -11.6 ± 0.2 |
| P4F-50%_w | 0.071 ± 0.004 | > $10^3$ | -8.3 ± 0.4 |
| P4F-33%_w | 0.055 ± 0.004 | > $10^3$ | -11.0 ± 1.0 |

**Table S6.** Electrical properties of P4TIF-HV_ac films.

| Sample | $\mu_{sat}$ [$cm^2V^{-1}s^{-1}$] | on/off | $V_T$ [V] |
|---|---|---|---|
| P4F-100%_ac | 0.071 ± 0.020 | > $10^3$ | -32.1 ± 6.9 |
| P4F-80%_ac | 0.030 ± 0.001 | > $10^3$ | -29.0 ± 3.1 |
| P4F-75%_ac | 0.030 ± 0.003 | > $10^3$ | -32.3 ± 5.1 |
| P4F-67%_ac | 0.026 ± 0.002 | > $10^3$ | -40.4 ± 3.3 |
| P4F-50%_ac | 0.037 ± 0.003 | > $10^3$ | -39.6 ± 3.6 |
| P4F-33%_ac | 0.038 ± 0.002 | > $10^3$ | -43.9 ± 3.8 |