Supplmentary information

1) Materials and methods

Chemical reagents and solvents were used as received from commercial sources. ^{1}H, ^{13}C, and ^{31}P NMR spectra were obtained on Varian Unity Inova 400, CD on a JASCO J-810 spectrometer, LC-MS on Waters Acouity ultra Performance LC with Waters MICROMASS detector, TEM on Morgagni 268 transmission electron microscope.

2) Synthesis of hydrogelator **1T**, **1G**, **1C and precursor 2T**, **2G**, **2C**.

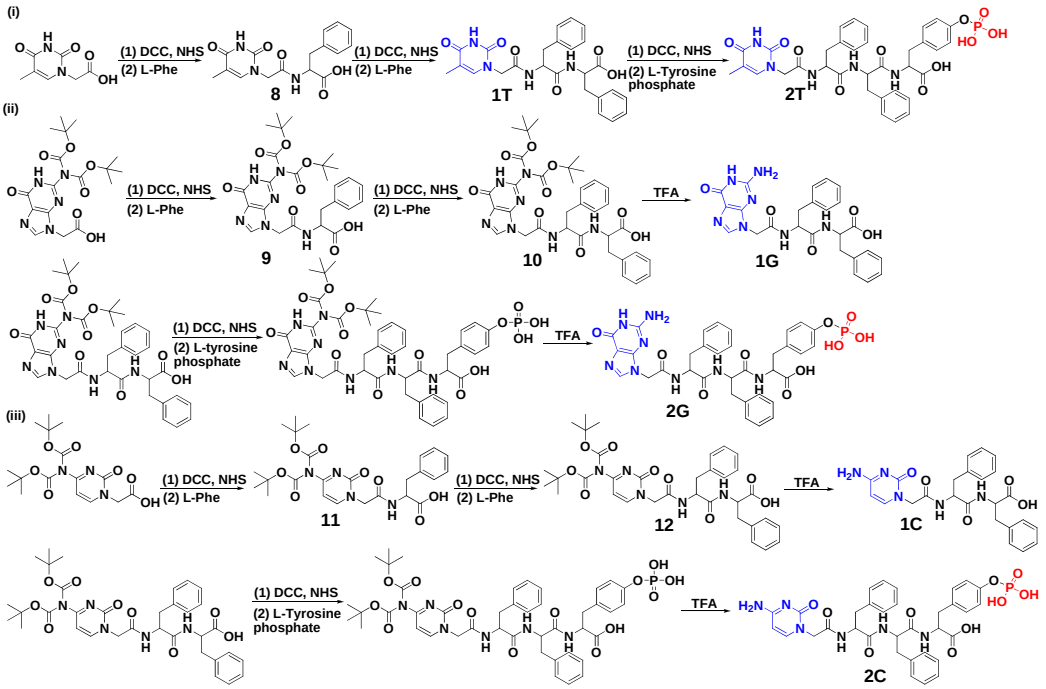


Figure S1. Molecular structures and the typical synthetic route of nucleopeptides **1T**, **2T**, **1G**, **2G**, **1C** and **2C**.

Synthesis of Bis-Boc-Adenine-Phe (5). Bis-Boc adenine acetic acid (393.4 mg, 1 mmol) and NHS (126.5 mg, 1.1 mmol) were dissolved in 30 mL of THF, and DCC (226.6 mg, 1.1 mmol) was added to the above solution with stirring. After the reaction mixture was stirred at room temperature overnight, the resulting solid was filtered off. The filtrate was evaporated under reduced pressure to dryness to afford the crude product for the next reaction without purification.

L-Phenylalanine (166 mg, 1 mmol) and Na_2CO_3 (84.8 mg, 0.8 mmol) were dissolved in 20 mL of water with stirring, and the solution of crude product (dissolved in 30 mL THF) was added. The resulted reaction mixture was stirred at room temperature for 24 h. After evaporation of the organic solvent, the residue was redissovled in 30 mL of water and acidified with hydrochloric acid to pH 2-3. The white precipitate was filtered off and purified by column chromatography over silica gel using chloroform/methanol as the eluents to afford compound **5** (443 mg, 82%) for next

step reaction. ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.80 (s, 1H), 8.66 (b, 1H), 8.50 (s, 1H), 7.27-7.17 (m, 5H), 5.03 (dd, *J* =20.0 Hz, 24.0 Hz, 2H), 4.37 (m, 1H), 3.08 (dd, *J* =4.0, 12.0 Hz, 1H), 2.92 (dd, *J* =8.0, 12.0 Hz, 1H), 1.37 (s, 18H) ppm.

Synthesis of Bis-Boc-Adenine-Phe-Phe (6). Compound **5** (540 mg, 1 mmol) and NHS (126.5 mg, 1.1 mmol) were dissolved in THF (30 mL), and DCC (226.6 mg, 1.1 mmol) was added to the above solution with stirring. After the reaction mixture was stirred at room temperature for 12 h, the resulting solid was filtered off. Then the filtrate was evaporated under reduced pressure to dryness. The crude product was used for the next step reaction without purification.

L-Phenylalanine (166 mg, 1 mmol) and Na_2CO_3 (84.8 mg, 0.8 mmol) were dissolved in water (20 mL) with stirring, and the solution of crude product (dissolved in 30 mL of THF) was added. The resulted reaction mixture was stirred at room temperature for 24 h. After evaporation of the organic solvent, the residue was redissovled in 30 mL of water and acidified with hydrochloric acid to pH 2-3. The white precipitate was filtered off and purified by column chromatography over silica gel using chloroform/methanol as the eluents to afford compound **6** (488 mg, 80%). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.78 (s, 1H), 8.70 (d, *J*=8.0 Hz, 1H), 8.49 (d, *J*=8.0 Hz, 1H), 8.42 (s, 1H), 7.24-7.10 (m, 10H), 4.96 (dd, *J* =16.0, 28.0 Hz, 2H), 4.61-4.56 (m, 1H), 4.46-4.40 (m, 1H), 3.09-2.99 (m, 2H), 2.91 (dd, *J* =8.0, 12.0 Hz, 1H), 2.75 (dd, *J* =8.0, 12.0 Hz, 1H), 1.37 (s, 18H) ppm.

Synthesis of Adenine-Phe-Phe (1A). 0.5 mmol of compound **6** (344 mg) was dissolved in 10 mL of 90% Trifluoroacetic acid in water and stirred at room temperature for 2 h. The reaction mixture was concentrated by vacuum and the white solid was purified by using HPLC with water-acetonitrile as eluent (from 8:2 to 4:6) to afford the product (**1A**) in 73% yield. ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.63 (d, *J* = 8.0 Hz, 1H), 8.51 (d, *J* = 8.4 Hz, 1H), 8.29 (s, 1H), 8.12 (s, 1H), 7.24-7.18 (m, 10H), 4.85 (dd, *J* = 29.6, 16.4 Hz, 2H), 4.60-4.55 (m, 1H), 4.46-4.41 (m, 1H), 3.06-2.96 (m, 2H), 2.90 (dd, *J* = 16.4, 10.0 Hz, 1H), 2.74 (dd, *J* = 13.6, 4.8 Hz, 1H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 37.2, 38.4, 45.9, 54.3, 54.5, 118.4, 127.1, 127.2 128.8, 128.9, 129.7, 129.9, 138.0, 144.8, 147.3, 149.5, 152.0, 166.1, 171.5, 173.4. MS: calcd M^+=487.51, obsd $(M+1)^+$=488.51.

Synthesis of Adenine-Phe-Phe-Tyr-phosphate (2A). Compound **6** (687.7 mg, 1 mmol) and NHS (126.5 mg, 1.1 mmol) were dissolved in THF (30 mL), and DCC (226.6 mg, 1.1 mmol) was added to the above solution with stirring. After the reaction, the mixture was stirred at room temperature for 12 h, and the resulted solid was filtered off. The filtrate was evaporated under reduced pressure to dryness. The crude product was used for the next reaction without purification.

L-Tyrosine-phosphate (261.17 mg, 1 mmol) and Na_2CO_3 (212 mg, 2 mmol) were dissolved in water (20 mL) with stirring, and the solution of crude product (dissolved

in 30 mL of THF) was added. The resulted reaction mixture was stirred at room temperature for 24 h. After evaporation of the organic solvent, the residue was redissovled in 30 mL of water and acidified with hydrochloric acid to pH 2. The white precipitate was filtered off and treated with 90% trifluoroacetic acid in water for 2 h. Then the mixture was concentrated by vacuum and purified by using HPLC with water-acetonitrile as eluent (from 8:2 to 5:5) to afford the product (**2A**) in 51% yield. ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.51 (d, J = 8.0 Hz, 1H), 8.32-8.26 (m, 1H), 8.13 (s, 1H), 7.96 (s, 1H), 7.62 (s, 1H), 7.26-7.06 (m, 14H), 4.78 (dd, J = 30.0, 16.8 Hz, 2H), 4.52-4.41 (m, 3H), 3.04-2.68 (m, 6H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 37.7, 38.6, 38.8, 45.8, 54.1, 54.5, 118.5, 120.4, 126.9, 127.2, 128.6, 128.8, 130.0, 130.8, 133.5, 137.8, 138.5, 144.4, 148.4, 150.0, 150.9, 153.0, 166.2, 171.0, 173.5. MS: calcd M^+=730.66, obsd $(M+Na)^+$=753.66.

Synthesis of Thymine-Phe (8). Thymine acetic acid (184 mg, 1 mmol) and NHS (126.5 mg, 1.1 mmol) were dissolved in 20 mL of DMF, and DCC (226.6 mg, 1.1 mmol) was added to the above solution with stirring. After the reaction, the mixture was stirred at room temperature overnight, and the resulted solid was filtered off. The filtrate was evaporated under reduced pressure to dryness, and the crude product was used in the next reaction without purification.

L-Phenylalanine (166 mg, 1 mmol) and Na_2CO_3 (84.8 mg, 0.8 mmol) were dissolved in 20 mL of water with stirring, and the solution of crude product (dissolved in 20 mL DMF) was added. The resulted reaction mixture was stirred at room temperature for 24 h. The reaction mixture was vacuum-dried, then 30 mL of water was added and acidified to pH=3. The resulted product was obtained by filtration, washed with water, and then dried in vacuum. The white solid was purified by using HPLC with water-acetonitrile as eluent (from 8:2 to 4:6) to afford the product (**8**) in 78% yield for next step reaction. ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.56-8.54 (m, 1H), 7.33-7.20 (m, 6H), 4.45-4.40 (m, 1H), 4.19 (dd, J=16.0, 28.0 Hz, 2H), 3.04 (dd, J=4.0, 12.0Hz, 1H), 2.89 (dd, J=8.0, 16.0Hz, 1H), 1.73 (s, 3H) ppm.

Synthesis of Thymine-Phe-Phe (1T). Compound **8** (331 mg, 1 mmol) and NHS (126.5 mg, 1.1 mmol) were dissolved in 20 mL of DMF, and DCC (226.6 mg, 1.1 mmol) was added to the above solution with stirring. After the reaction mixture was stirred at room temperature overnight, the resulted solid was filtered off, and the filtrate was evaporated under reduced pressure to dryness. The crude product was used in the next reaction without purification.

L-Phenylalanine (166 mg, 1 mmol) and Na_2CO_3 (84.8 mg, 0.8 mmol) were dissolved in 20 mL of water with stirring, and the solution of crude product (dissolved in 20 mL DMF) was added. The resulted reaction mixture was stirred at room temperature for 24 h. The reaction mixture was vacuum-dried, then 30 mL of water was added and the mixture was acidified to pH=3. The resulted product was obtained by filtration, washed with water, and then dried in vacuum. Compound **1T** (white powder) was

collected with 76% yield (364 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.41-8.37 (m, 1H), 7.29-7.18 (m, 10H), 4.57-4.52 (m, 1H), 4.43-4.38 (m, 1H), 4.23 (dd, J = 16.8, 28.4 Hz, 2H), 3.06-2.89 (m, 3H), 2.72 (dd, J = 9.6, 15.2 Hz, 1H), 1.71 (s, 3H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 12.6, 38.4, 49.5, 55.0, 55.6, 108.6, 126.6, 126.9, 128.5, 128.7, 130.0, 130.1, 138.5, 139.3, 142.8, 151.6, 165.0, 167.3. MS: calcd M^+=478.50, obsd $(M+1)^+$=479.50.

Synthesis of Thymine-Phe-Phe-Tyr-phosphate (2T). Compound **1T** (478.5 mg, 1 mmol) and NHS (126.5 mg, 1.1 mmol) were dissolved in DMF (30 mL), and DCC (226.6 mg, 1.1 mmol) was added to the above solution with stirring. After the reaction mixture was stirred at room temperature for 12 h, the resulted solid was filtered off, and the filtrate was evaporated under reduced pressure to dryness. The crude product was used for the next reaction without purification.

L-Tyrosine-phosphate (261.17 mg, 1 mmol) and Na_2CO_3 (212 mg, 2 mmol) were dissolved in water (20 mL) with stirring, and the solution of crude product (dissolved in 30 mL of DMF) was added. The resulted reaction mixture was stirred at room temperature for 24 h. The reaction mixture was vacuum-dried, then 30 mL of water was added and the mixture was acidified to pH~2.0. The resulted product was isolated by filtration, washed with water, and then dried in vacuum. The white solid was purified by using HPLC with water-acetonitrile as eluent (from 8:2 to 5:5) to afford the product (**2T**) in 53% yield (382 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.29 (dd, J = 9.2, 32.0 Hz, 1H), 7.26-7.06 (m, 14H), 4.56-4.42 (m, 3H), 4.23 (d, J = 4.8 Hz, 2H), 3.03-2.88 (m, 4H), 2.81-2.67 (m, 2H), 1.71 (s, 3H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 12.6, 36.6, 38.1, 38.3, 49.6, 54.4, 55.6, 108.5, 120.4, 126.9, 128.7, 130.0, 130.5, 138.2, 138.4, 142.9, 151.6, 165.1, 167.2, 171.2, 171.9, 173.3. MS: calcd M^+=721.65, obsd $(M+Na)^+$=744.65.

Synthesis of Bis-Boc-Guanine-Phe (9). Compound **9** was synthesized by following the procedures described in synthesis of compound **5** except replacing the bis-Boc adenine acetic acid with bis-Boc guanine acetic acid. Compound **1Ga** (white powder) was collected with 81% yield (462 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.71 (d, J=8.0 Hz, 1H), 8.51 (d, J=8.0 Hz, 1H), 7.31-7.19 (m, 5H), 4.91-4.79 (m, 2H), 4.44 (m, 1H), 3.06-3.01 (m, 2H), 2.94-2.88 (m, 2H), 1.34 (s, 18H) ppm.

Synthesis of Bis-Boc-Guanine-Phe-Phe (10). Compound **10** was synthesized by following the procedures described in synthesis of compound **6** except replacing the bis-Boc adenine acetic acid with bis-Boc guanine acetic acid. Compound **10** (white powder) was collected with 75% yield (528 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.52 (d, J=8.0 Hz, 1H), 8.45 (s, 1H), 7.93 (s, 1H), 7.23-7.17 (m, 10H), 4.83-4.70 (m, 2H), 4.56 (s, 1H), 4.40 (s, 1H), 3.08-2.99 (m, 2H), 2.92-2.71 (m, 2H), 1.33 (s, 18H) ppm.

Synthesis of Guanine-Phe-Phe (1G). Compound **1G** was synthesized by following

the procedures described in synthesis of compound 1A except replacing the bis-Boc adenine acetic acid with bis-Boc guanine acetic acid. Compound **1G** (white powder) was collected with 58% yield (292 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.56-8.51 (m, 2H), 7.71 (s, 1H), 7.26-7.18 (m, 10H), 4.70 (s, 2H), 4.60-4.54 (m, 1H), 4.45-4.40 (m, 1H), 3.09-2.96 (m, 2H), 2.93-2.87 (m, 1H), 2.76-2.70 (m, 1H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 37.3, 38.7, 45.7, 54.3, 54.4, 127.0, 127.2, 128.7, 128.9, 129.8, 130.0, 138.1, 138.2, 166.3, 171.5, 173.4. MS: calcd M^{+}=503.51, obsd $(M+1)^{+}$=504.51.

Synthesis of Guanine-Phe-Phe-Tyr-phosphate (2G). Compound **2G** was synthesized by following the procedures described in synthesis of compound 2A except replacing the bis-Boc adenine acetic acid with bis-Boc guanine acetic acid. Compound **2G** (white powder) was collected with 51% yield (381 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.53 (t, J = 8.0 Hz, 1H), 8.42 (s, 1H), 8.27 (t, J = 8.0 Hz, 1H), 7.61 (s, 1H), 7.26-7.06 (m, 14H), 4.66-4.36 (m, 5H), 3.07-2.67 (m, 6H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 22.9, 37.3, 38.2, 44.4, 45.7, 46.3, 54.4, 54.6, 55.6, 113.2, 120.1, 127.0, 128.8, 129.8, 130.9, 132.8, 138.1, 138.4, 139.0, 151.3, 154.8, 166.2, 171.0, 171.5, 171.9, 173.4. MS: calcd M^{+}=746.66, obsd $(M+Na)^{+}$=769.66.

Synthesis of Bis-Boc-Cytosine-Phe (12). Compound **12** was synthesized by following the procedures described in synthesis of compound **5** except replacing the bis-Boc adenine acetic acid with bis-Boc cytosine acetic acid. Compound **12** (white powder) was collected with 83% yield (429 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.29 (s, 1H), 8.01 (d, J=4.0 Hz, 1H), 7.22-7.16 (m, 5H), 6.79 (d, J=8.0 Hz, 1H), 4.58-4.41 (m, 2H), 4.27 (s. 1H), 1.49 (s, 18H) ppm.

Synthesis of Bis-Boc-Cytosine-Phe-Phe (13). Compound **13** was synthesized by following the procedures described in synthesis of compound **6** except replacing the bis-Boc adenine acetic acid with bis-Boc cytosine acetic acid. Compound **13** (white powder) was collected with 78% yield (518 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.51 (d, J=8.0 Hz, 1H), 8.41 (d, J=8.0 Hz, 1H), 7.94 (d, J=8.0 Hz, 1H), 7.29-7.16 (m, 10H), 6.77 (d, J=8.0 Hz, 1H), 4.58-4.38 (m, 4H), 3.07-2.71 (m, 4H), 1.48 (s, 18H) ppm

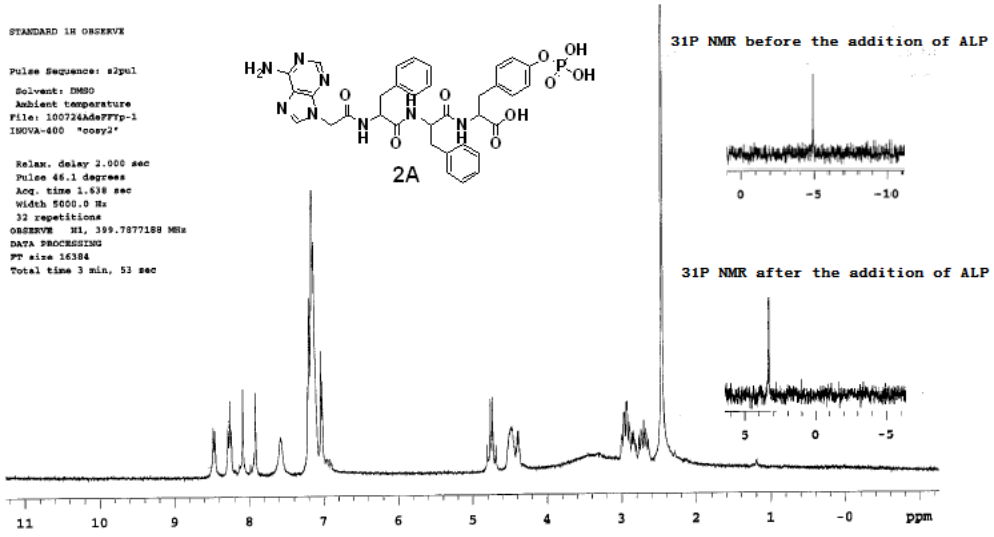
Synthesis of Cytosine-Phe-Phe (1C). Compound **1C** was synthesized by following the procedures described in synthesis of compound **1A** except replacing the bis-Boc adenine acetic acid with bis-Boc cytosine acetic acid. Compound **1C** (white powder) was collected with 61% yield (283 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.87 (s, 1H), 8.48 (d, J = 7.6 Hz, 2H), 8.16 (s, 1H), 7.66 (d, J = 7.6 Hz, 1H), 7.30-7.16 (m, 10H), 5.91 (d, J = 8.4 Hz, 1H), 4.59-4.54 (m, 1H), 4.45-4.41 (m, 3H), 3.01-2.90 (m, 3H), 2.75-2.70 (m, 1H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 36.7, 37.8, 50.4, 53.7, 93.1, 126.4, 126.5, 128.1, 128.3, 129.2, 129.4, 137.6, 149.7, 161.6, 166.1, 170.9, 172.8. MS: calcd M^{+}=463.49, obsd $(M+1)^{+}$=464.49.

Synthesis of Cytosine-Phe-Phe-Tyr-phosphate (2C). Compound **2C** was synthesized by following the procedures described in synthesis of compound **2A** except replacing the bis-Boc adenine acetic acid with bis-Boc cytosine acetic acid. Compound **2C** (white powder) was collected with 51% yield (360 mg). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.54-8.42 (m, 2H), 8.24-8.19 (m, 1H), 7.62 (s, 1H), 7.26-7.06 (m, 14H), 5.85 (d, J = 7.2 Hz, 1H), 4.54-4.45 (m, 5H), 3.04-2.66 (m, 6H). ^{13}C NMR (400 MHz, DMSO-d_6): δ 36.5, 37.9, 51.4, 54.4, 54.8, 93.8, 120.6, 126.9, 128.7, 129.9, 130.6, 138.2, 149.0, 151.7, 158.5, 170.9, 173.2. MS: calcd M^{+}=706.64, obsd $(M+Na)^{+}$=729.64.

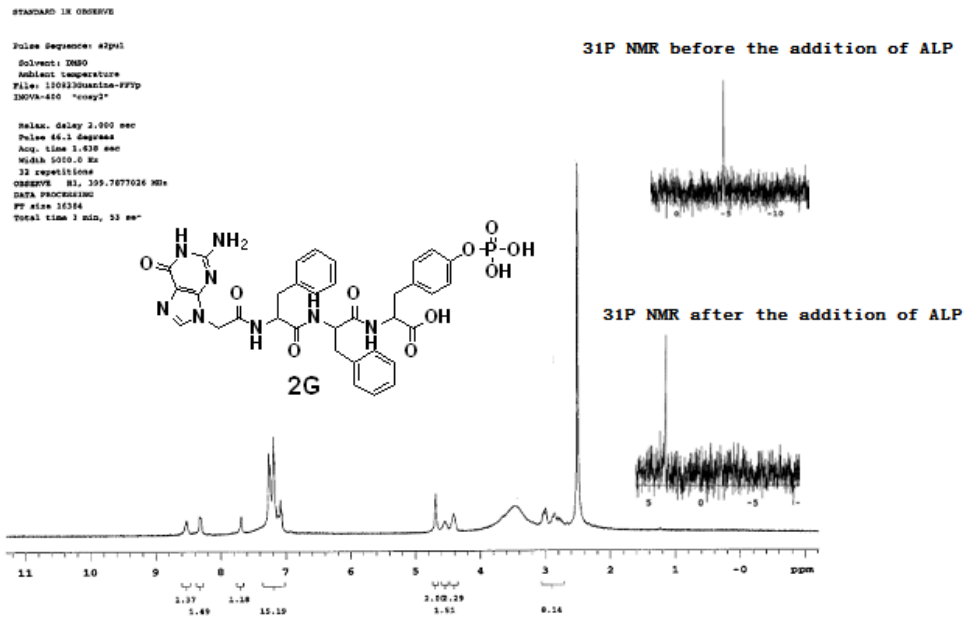
3) Gelation test of precursor 2 triggered by alkaline phosphatase

We dissolved 6.0 mg of precursor **2** in 300 μL of water at pH = 7.4 to make a clear solution, then followed by adding 10 unit of alkaline phosphatase in 1 μL to afford a translucent hydrogel.

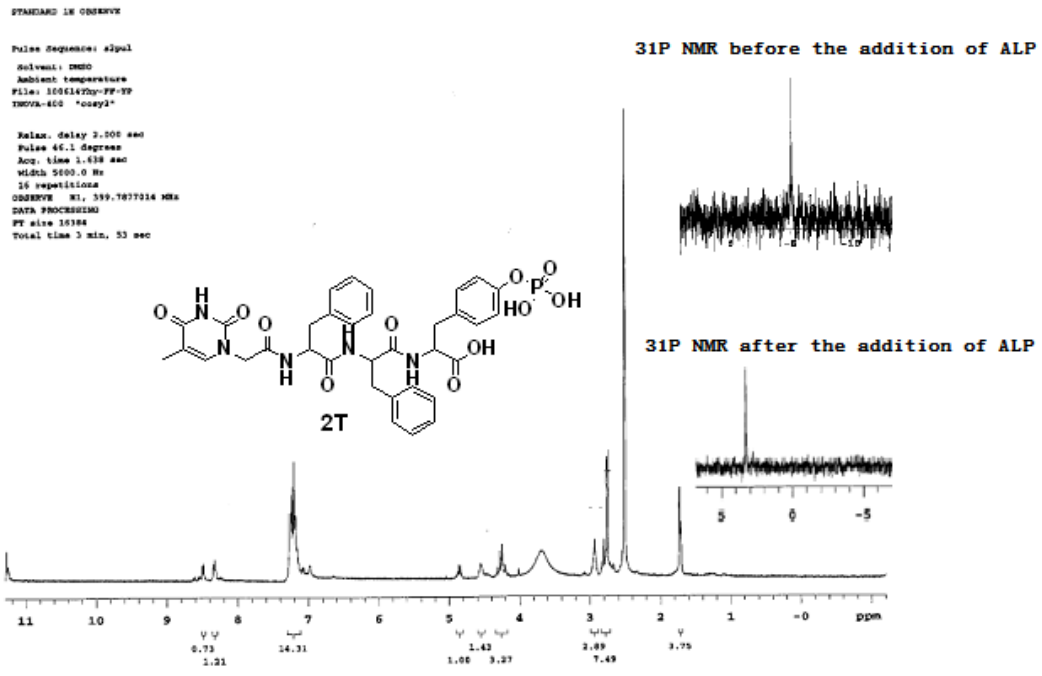
(a)



(b)


31P NMR before the addition of ALP
31P NMR after the addition of ALP
2G

(c)


31P NMR before the addition of ALP
31P NMR after the addition of ALP
2T

(d)

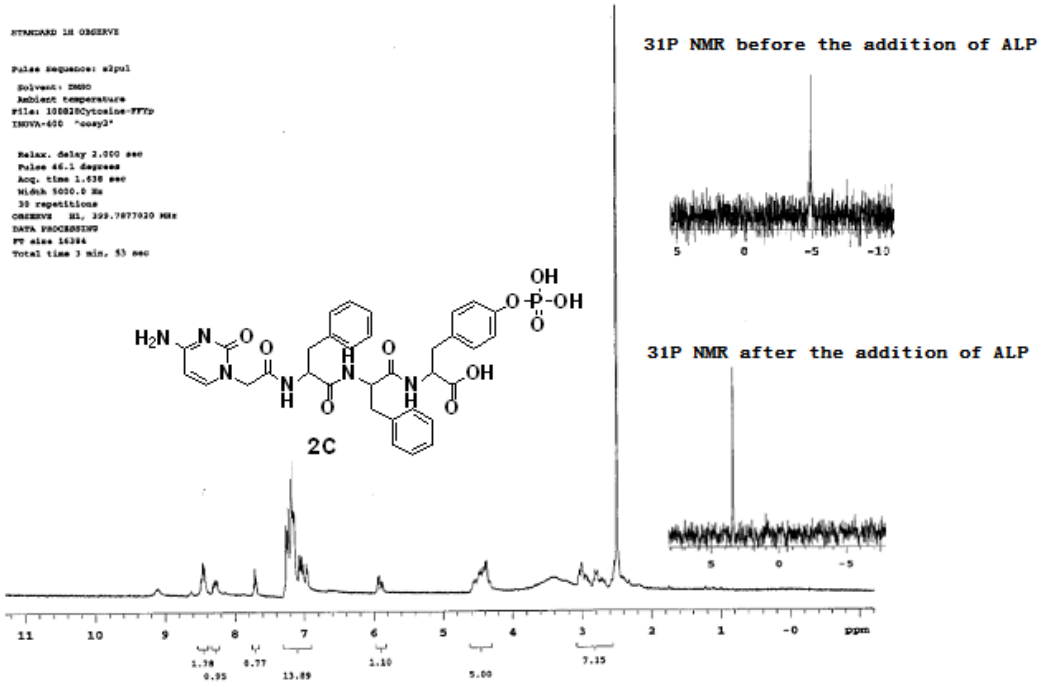


Figure S2. ^{1}H NMR of nucleopeptide hydrogelators **2A**, **2G**, **2T** and **2C** and the ^{31}P NMR before and after the addition of alkaline phosphatase (ALP).

4) Preparation of 1T+deoxyadenosine (A_{10}), 3T+deoxyadenosine (A_{10}) mixed gels and test of the interaction between hydrogelator and deoxyadenosine (A_{10})

The typical procedure for **1T**+deoxyadenosine (A_{10}) mixed gel: 4 mg of **1T** dissolves in 158 μL water at pH 9 with gentle heating to make clear solution, followed by the addition of 42 μL of deoxyadenosine (A_{10}) (20 mM) to afford stable mixed hydrogel at pH 5. And this mixed hydrogel was subject to CD, rheological studies to test the interaction between **1T** and deoxyadenosine (A_{10}).

The typical procedure for **3T**+deoxyadenosine (A_{10}) mixed gel: 4 mg of **2T** dissolves in 172 μL buffer at pH 7.4 with gentle heating to make clear solution, followed by the addition of 28 μL of deoxyadenosine (A_{10}) (20 mM) and subsequent treatment with alkaline phosphatase to afford stable mixed hydrogel. And this mixed hydrogel was subject to CD, rheological studies to test the interaction between **3T** and deoxyadenosine (A_{10}).

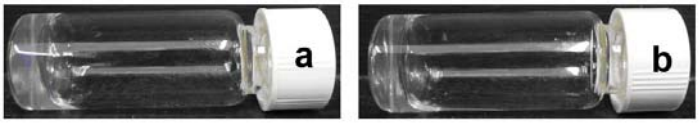


Figure S3. Optical images of (**a**) **1T**+deoxyadenosine (A_{10}) mixed gel; (**b**) **3T**+deoxyadenosine (A_{10}) mixed gel triggered by alkaline phosphatase.

5) CD measurement.

CD spectra were recorded (185-350 nm) using a JASCO 810 spectrometer under a nitrogen atmosphere. The hydrogels (0.2 ml, 2.0 wt %) were placed evenly on the 1 mm thick quartz curvet and scanned with 0.5 nm interval.

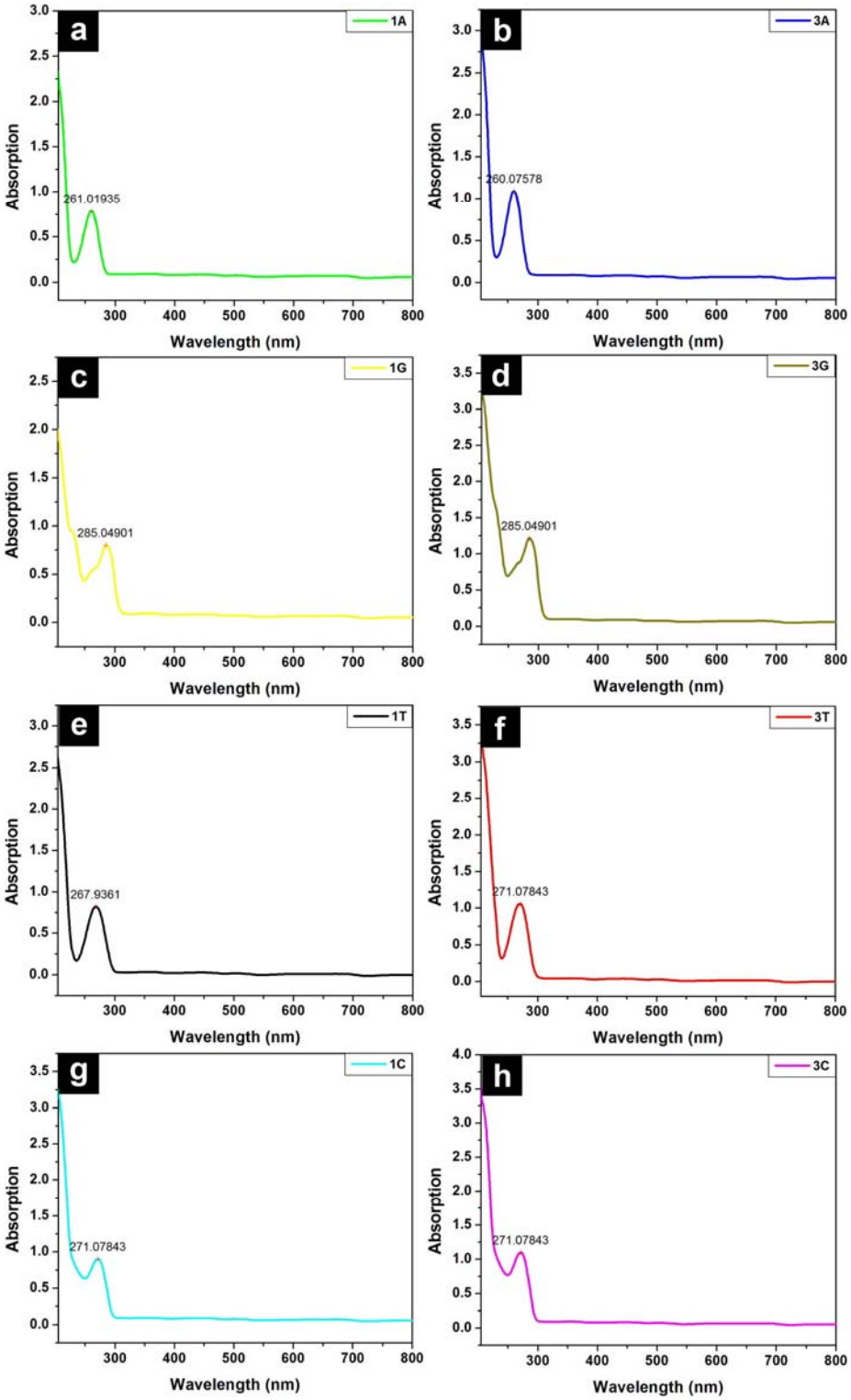


Figure S4. UV-vis absorption spectrum of the solution of (**a**) **1A**; (**b**) **3A**; (**c**) **1G**; (**d**) **3G**; (**e**) **1T**; (**f**) **3T**; (**g**) **1C**; (**h**) **3C**, which indicates that there is no chromophoric

absorption around 300 nm in solution state ($c = 5.0\times10^{-4}$ M).

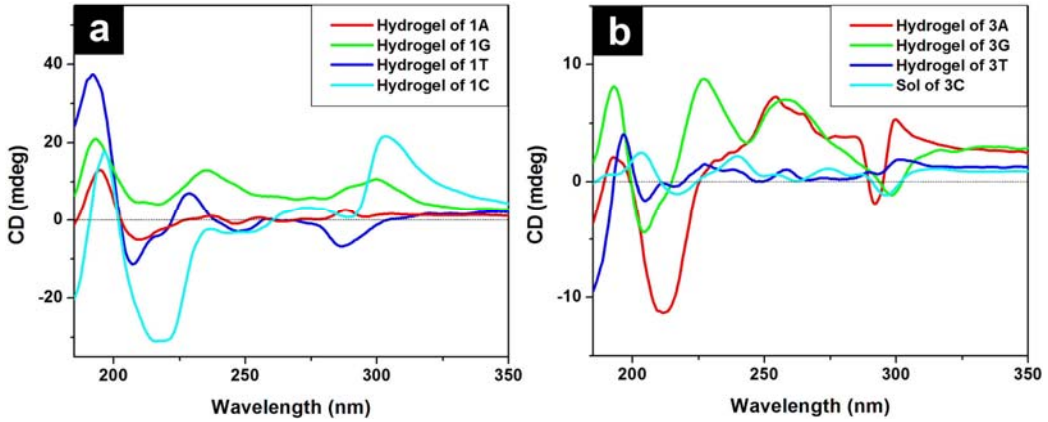


Figure S5. CD spectra of (**a**) the hydrogels formed by hydrogelator **1A**, **1G**, **1T** and **1C**; (**b**) the hydrogels formed by **3A**, **3G**, and **3T** and the solution of **3C**.

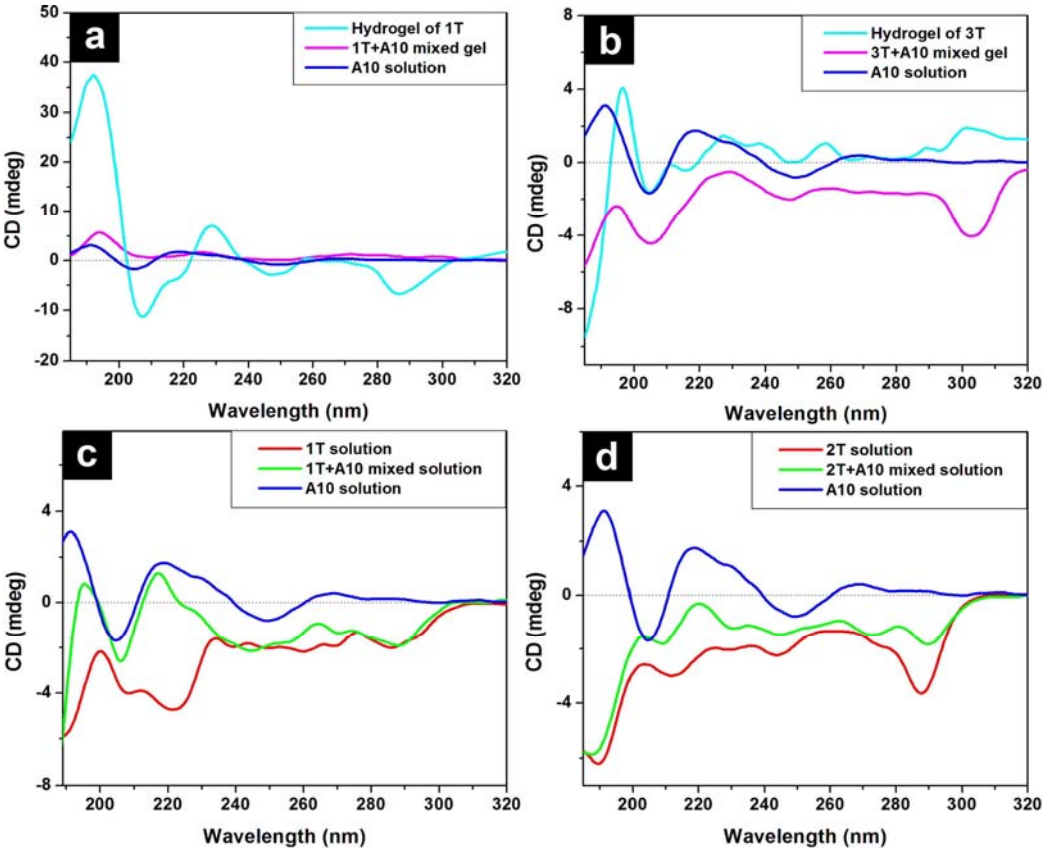


Figure S6. CD spectra of (**a**) the hydrogel of **1T**, the solution of deoxyadenosine (A_{10}), and the hydrogel of **1T** mixed with deoxyadenosine (A_{10}) in 1:1 molecular ratio; (**b**) the hydrogel of **3T**, the solution of deoxyadenosine (A_{10}), and the hydrogel of **3T** mixed with deoxyadenosine (A_{10}) in 1:1 molecular ratio triggered by alkaline phosphatase; (**c**) the solution **1T (**10 mM**)**, the solution of deoxyadenosine (A_{10}), and

the mixture solution of **1T** with deoxyadenosine (A_{10}) in 1:1 molecular ratio; (**d**) the solution **2T (**10 mM**)**, the solution of deoxyadenosine (A_{10}), and the mixture solution of **2T** with deoxyadenosine (A_{10}) in 1:1 molecular ratio.

6) Rheological measurements

Rheological tests were conducted on TA ARES G2 rheometer (with TA Orchestrator Software). 25 mm parallel plate was used during the experiment. 0.5 mL of hydrogel sample was placed on the parallel plate.

i) Dynamic Strain Sweep Test

Test range (0.1 to 10% strain, frequency = 10 $rads^{-1}$), 10 points per decade. Sweep mode is "log" and temperature was carried out at 25^{o} C.

ii) Critical strain determination

The critical strain (γ_c) value was determined from the storage-strain profiles of the hydrogel sample. The strain applied to the hydrogel sample increased from 0.1 to 100% (10 rad/s and 25^{o}C). Over a certain strain, a drop in the elastic modulus was observed, and the strain amplitude at which storage moduli just begins to decrease by 5% from its maximum value was determined and taken as a measure of the critical strain of the hydrogels, which correspond to the breakdown of the crosslinked network in the hydrogel sample.

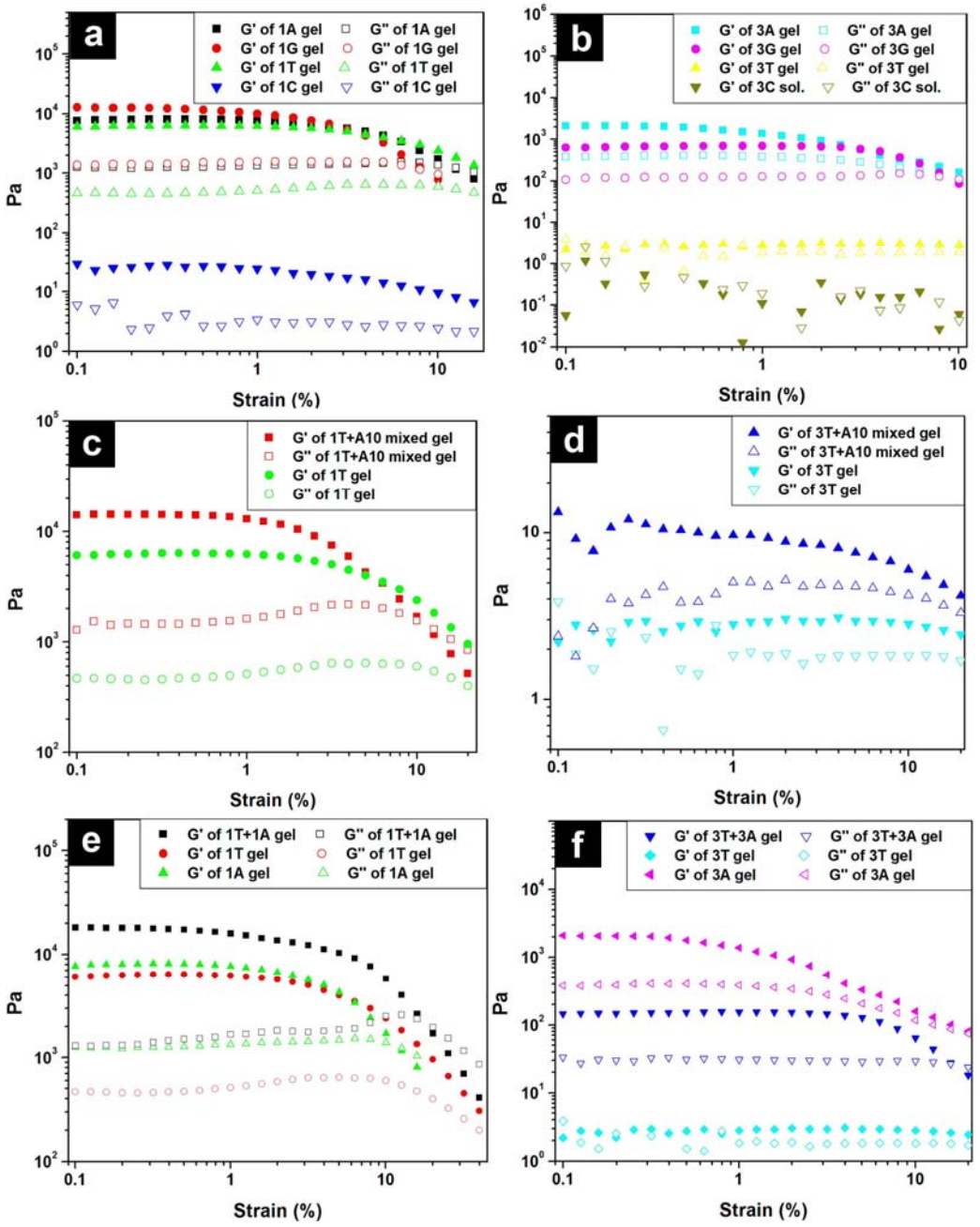


Figure S7. Strain dependence of the dynamic storage moduli (G') and the loss moduli (G") of (**a**) the hydrogels formed by hydrogelator **1A**, **1G**, **1T**, **1C**; (**b**) the hydrogels formed by hydrogelator **3A**, **3G**, **3T** and solution **3C**; (**c**) the mixed hydrogel of **1T**+ deoxyadenosine (A_{10}); (**d**) the mixed hydrogel of **3T**+ deoxyadenosine (A_{10}); (**e**) the mixed hydrogel of **1T**+**1A**; **(f)** the mixed hydrogel of **3T**+**3A**.

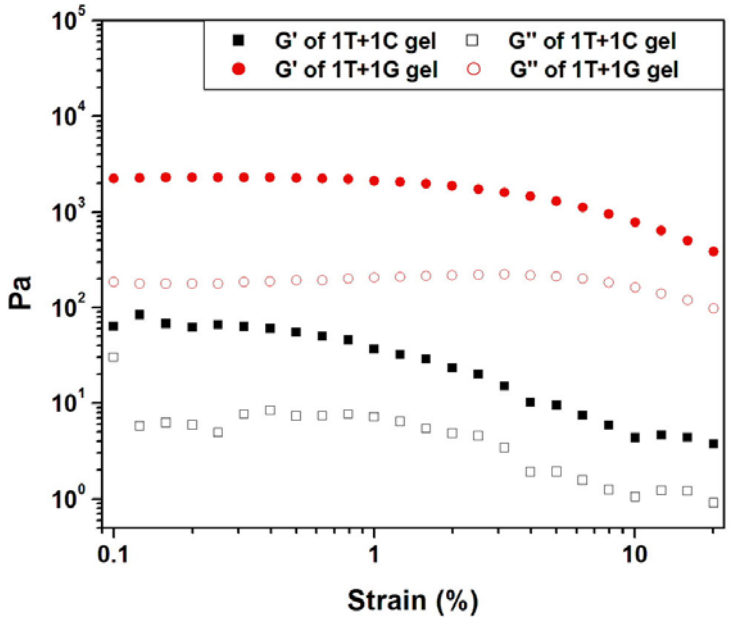


Figure S8. Strain dependence of the dynamic storage moduli (G') and the loss moduli (G") of the mixed hydrogel of **1T**+**1C**; and the mixed hydrogel of **1T**+**1G.**

7) Simulation of the width of the nanofibers by molecular mechanical (MM) calculation

Molecular mechanics (MM) calculations[S1-S3] were carried out to simulate the nanofibers of nucleopeptides with different diameters using the Dreiding Force Field[S4] as implemented in the molecular modeling programs (Accelrys Inc., San Diego, CA, USA). The initial crystal parameters of nucleopeptides were obtained from NapFF crystal structure. And then, the crystal structures of nucleopeptides were optimized by MM method. We determined the crystal growth habit of the nucleopeptide nanofibers by employing the Bravais-Friedel-Donnay-Harker (BFDH) method. We found all growth habits of the nanofibers are in the order of A>B>C axes. Accordingly, we fixed the long axis (A axis) to 33 unit cells and varied the widths (B axis) of the nanofibers to calculate the stabilization energy of the nanofibers. The width dependences of the stabilization energies are shown in Figure S1.

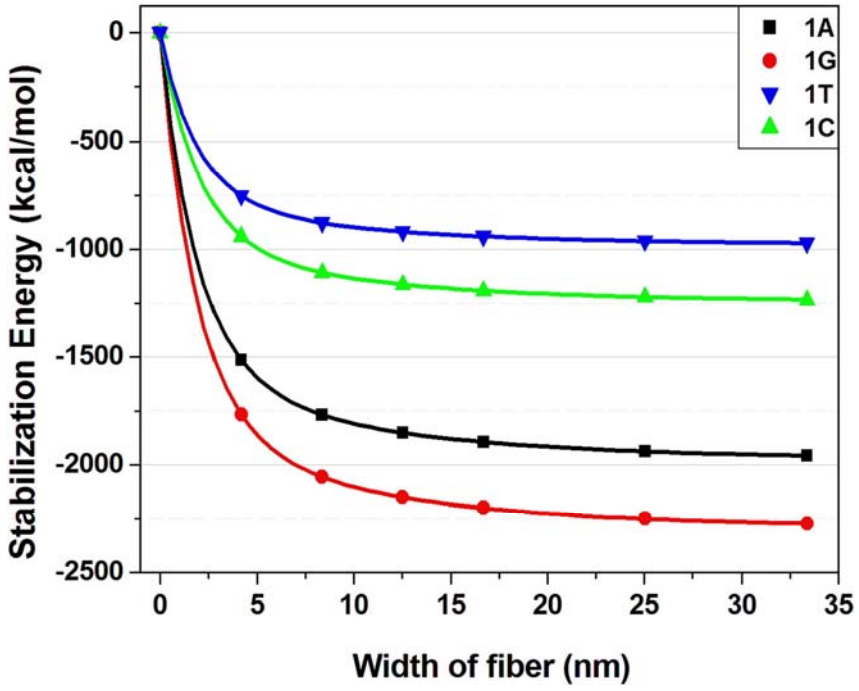


Figure S9. Calculated fiber width dependence of the stabilization energy of **1A**, **1G**, **1T** and **1C**.

Nonlinear curve fittings were carried out by three exponential functions

$$y = y_0 + A_1 e^{-x/b_1} + A_2 e^{-x/b_2} + A_3 e^{-x/b_3}$$

where A_n and b_n coefficients are calculated by the iterative method. Based on this method, we obtained four y_0 (i.e. the stabilization energy with infinity width). We fixed 1T to 9 nm as a reference and then we can calculate the energy difference as the scaling factor based on y_0 of 1T. According to this reference energy, we can estimate fiber diameters for other nucleopeptide nanofibers (Figure S2). Finally, we found that the simulated fiber diameters of nucleopeptides are in good agreement with the experimental data observed by TEM.

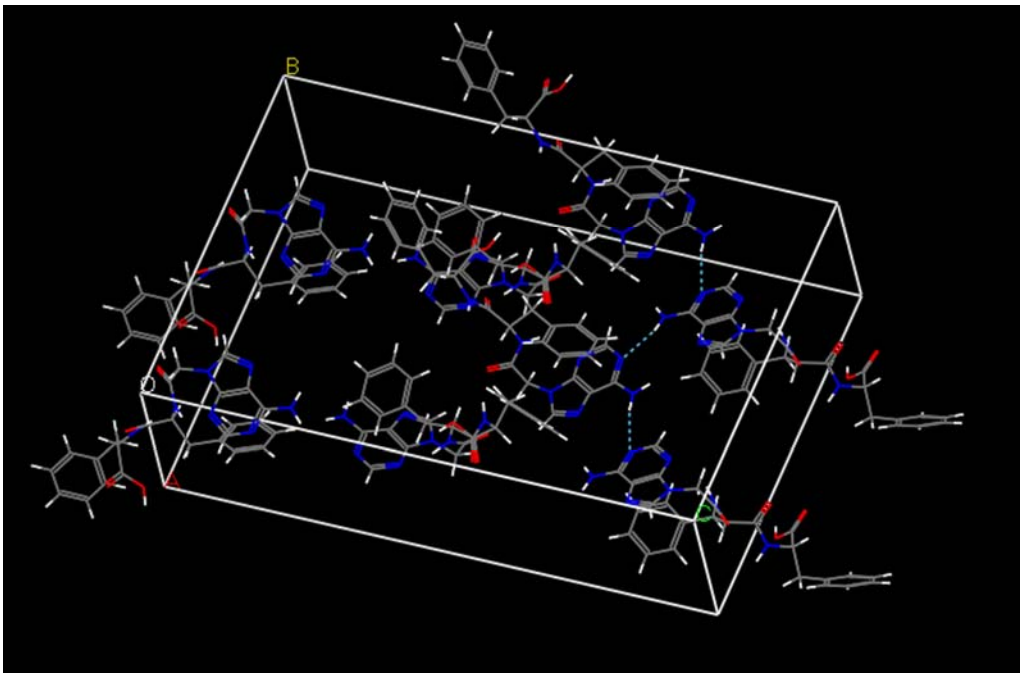


Figure S10. Optimized crystal structures of **1A**. Dashed lines (·····) indicate the Hoogsteen interactions among the nucleobases in the packed structures.

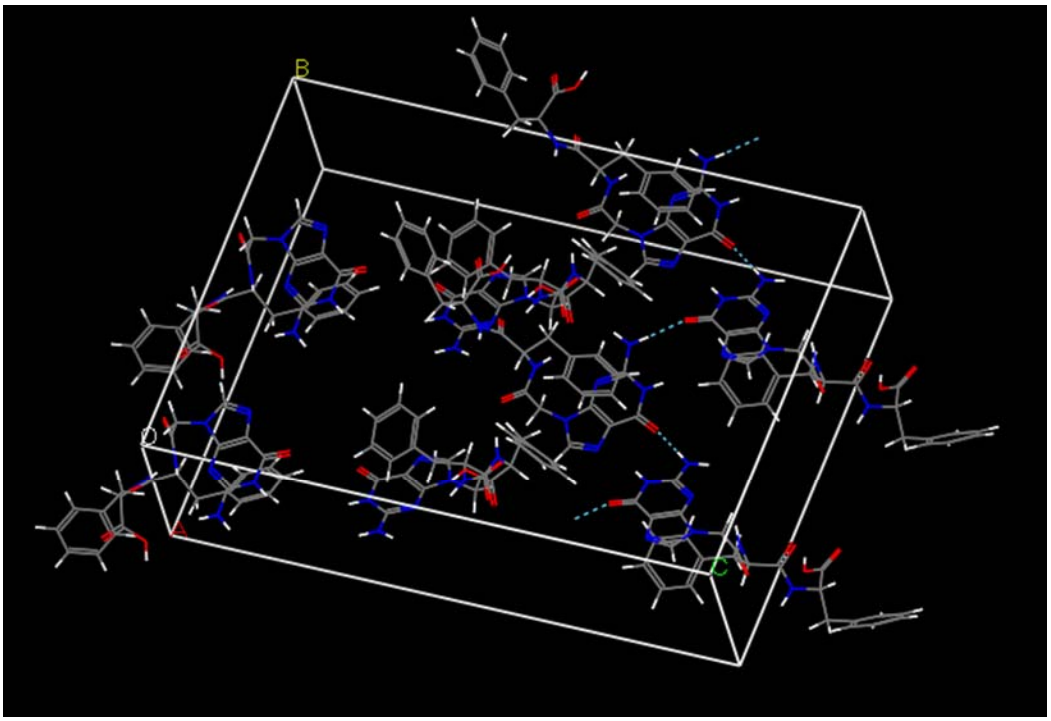


Figure S11. Optimized crystal structures of **1G**. Dashed lines (·····) indicate the Hoogsteen interactions among the nucleobases in the packed structures.

8) Wound-healing assay

HeLa cells were re-suspended in 10 cm tissue culture dish after washing cells once with PBS. 0.8 mL 0.25 % trypsin containing 0.1 % EDTA was then added, and the cells were re-suspended with 1.6mL complete medium. 5000 cells (in 100 μL medium) were plated into each vial on a 96 well plate to create a confluent monolayer. After adherent for 24 hr, a wound was created by scraping the cell monolayer with a p200 pipet tip. The cells were washed once with 100 μL of complete medium to remove flowing cells and replace with 100 μL of complete medium. 0 hr image was acquired as a reference point. The medium was replaced with 100 μL of medium containing 27.7 mM of hydrogel **3T** and the plate was incubate at 37 ºC, 5 % CO_2 for 20 hr. 0 hr and 20 hr images were acquired at the match photographed region.

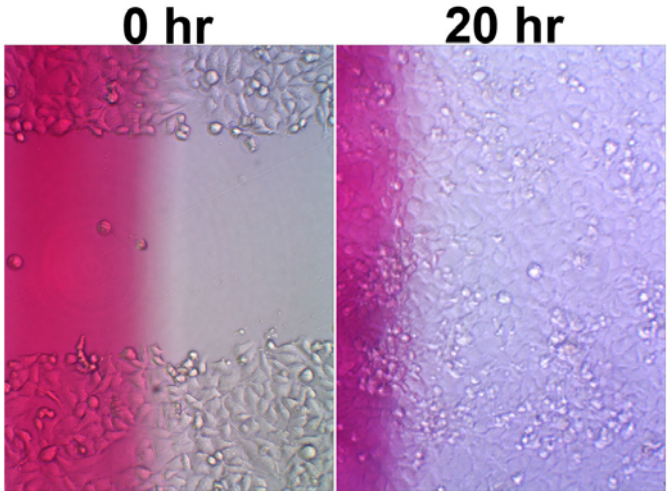


Figure S12. Optical images of HeLa cells on the surface 0 h and 20 h after the creation of scratch-wound in the medium without the presence of the hydrogel of **3T**.

9) Biostability test with proteinase K

1 mg of each compound was dissolved in 5 mL HEPES buffer at pH=7.5. Then proteinase K were added in concentration 3.2 units/mL and incubated at 37 ^{o}C for 24 hr, then 100 μL of sample were taken out each time and analyzed by HPLC.

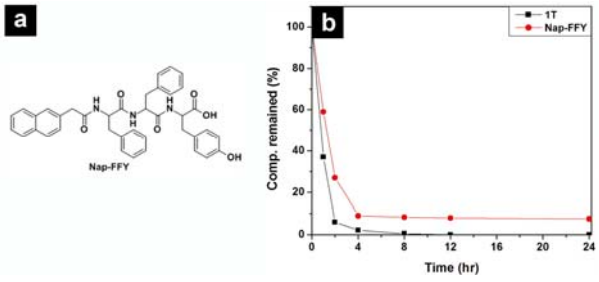


Figure S13. The molecular structure of Nap-FFY; and (d) the time-dependent course of the digestions Nap-FFY and **1T** by proteinase K, in which NapFFY is the tripeptide derivative.

References

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S4. Mayo, S. L.; Olafson, B. D.; Goddard W. A. III *J. Phys. Chem.* **1990**, *94*, 8897.