Electronic Supporting Information

for

Self-assembly formation of supramolecular hydrogen bonding pyridyl urea gels as soft matter with selective antibacterial properties against MRSA and/or E-coli

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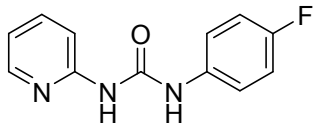
1: Synthesis and characterisation of pyridyl urea analogues 1-12.

General Procedure for the synthesis of 1-12.

Pyridyl amine (1mmol) was treated with appropriate isocyanate in (1.1mmol) in 20ml of acetonitrile. Reaction was carried out in microwave reactor for 50 mins at 100^0C. Reaction mixture was gravity filtered and slow evaporation of the solvents yielded amorphous powders and crystalline samples in the case of **1**, **2, 3** and **4**. Other analogues were purified by recrystallisation using hot acetonitrile/methanol solutions.

1.1Characterisation of 2-pyridylurea analogues 1-4

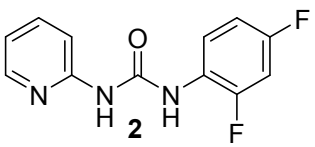
1-(4-fluorophenyl)-3-(pyridin-2-yl)urea, 1:



1

White needles in hot acetonitrile. Yield = 88.6% (217.5 mg). ^{1}H NMR (400 MHz, DMSO-d_6): 11.03 (s, 1H), 9.85 (s, 1H), 8.27-8.22 (m, 2H), 7.78-7.74 (m, 1H), 7.40 (d, 1H, J= 8.2Hz), 7.28- 7.23 (m, 1H), 7.16 (t, 1H, J = 15.6 Hz), 7.07-7.00 (m, 2H). ^{13}C NMR (100 MHz, DMSO-d_6, ^{19}F-coupling included): 153.49, 152.78, 152.07, 150.89, 146.54, 138.75, 127.19, 127.08, 124.58, 124.54, 123.00, 122.93, 120.88, 117.61, 115.06, 114.87, 112.01. HRMS calcd. for $C_{12}H_{11}N_3OF$: 232.0886. Found: 232.0891. IR (cm^{-1}): 3064.3, 2983.3, 1694.6, 1558.9, 1457.7, 1417.6, 1323.3, 1239.5, 1193.1, 774.9, 749.8, 695.0. Elemental analysis calcd. for $C_{12}H_{10}FN_3O$: C, 62.33; H, 4.36; N, 18.17. Found: C, 62.19; H, 4.27; N, 18.17. Melting point: 197.3-197.5°C.

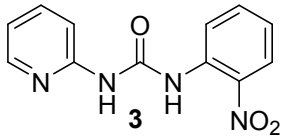
1-(2,4-difluorophenyl)-3-(pyridin-2-yl)urea, 2:



2

White coloured crystalline needles from hot methanol. Yield = 193mg (72.4%). ^{1}H NMR (400 MHz, DMSO-d_6): 10.98 (s, 1H), 9.80 (s, 1H), 8.27- 8.16 (m, 2H), 7.74 (t, 1H, J =15.6Hz), 7.35 (dd, 2H, J = 16.92 Hz), 7.09-7.01 (m, 2H). ^{13}C NMR (100 MHz, DMSO-d_6, ^{19}F-coupling included): 152.7, 152.16, 146.54, 138.79, 123.60, 122.11, 122.02, 117.64, 112.00, 111.19, 110.97, 104.06, 103.79, 103.56. HRMS calcd. for $C_{12}H_{10}F_2N_3O$ = 250.792. Found mass = 250.0790. IR (cm^{-1}): 3203.0, 2984.2, 1696.0, 1567.0, 1477.5, 1418.8, 1323.9, 1286.7, 1242.2, 1203.8, 1099.8, 956.7, 848.4, 774.6, 727.0, 672.0. Elemental analysis calcd. for $C_{12}H_9F_2N_3O$: C, 57.83; H, 3.64; N, 16.86; Found: C, 57.71; H, 3.52; N, 16.89; Melting point: 182.0 – 182.4 °C.

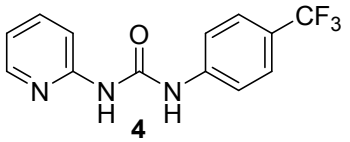
1-(2-nitrophenyl)-3-(pyridin-2-yl)urea, 3:



3

Yellow crystalline needles obtained by slow evaporation of acetonitrile**.** Yield: 250 mg (94%). ^{1}H NMR (400 MHz, DMSO-d_6): 12.33 (s, 1H), 10.18 (s, 1H), 8.45 (dd, 1H, J = 8.4Hz), 8.33-8.31 (m, 1H), 8.09 (dd, 1H, J = 8.4Hz), 7.80-7.69 (m, 2H), 7.28-7.23 (m, 2H), 7.078-7.04 (m, 1H). ^{13}C NMR (100 MHz, DMSO-d_6): 152.89, 152.60, 146.72, 139.34, 130.10, 135.16, 134.46, 125.77, 123.84, 123.32, 118.29, 112.49. IR (cm^{-1}): 2918.1, 2849.9, 1686.7, 1581.0, 1468.3, 1340.49, 1219.4, 1125.8, 763.84, 720.3, 672.12. HRMS calcd. for $C_{12}H_{11}N_4O_3$: 259.0831. Found: 259.0838. Elemental analysis calcd. for $C_{12}H_{10}N_4O_3$: C, 55.81; H, 3.90; N, 21.70. Found: C, 55.74; H, 3.90; N, 21.97.

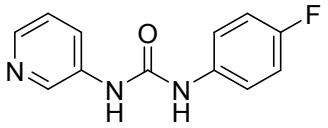
1-(pyridin-2-yl)-3-(4-(trifluoromethyl)phenyl)urea, 4:



4

Isolated as colorless amorphous powder. Yield: 265 mg (88.7%). ^{1}H NMR (400 MHz, DMSO-d_6): 10.03 (s, 1H), 9.58 (s, 1H), 8.35 (d, 1H, J=4 Hz), 7.84-7.70 (m, 3H), 7.67 (d, 2H, J= 8 Hz), 7.53 (d, 1H, J = 8 Hz), 7.13-6.99 (m, 1H). ^{13}C NMR (100 MHz, DMSO-d_6): 152.55, 152.05, 147.00, 142.76, 138.67, 126.18, 126.14, 126.11, 125.82, 123.13, 122.89, 122.58, 121.94, 118.50, 117.85, 112.02. HRMS calcd. for $C_{13}H_{10}F_3N_3O$: 280.0698, Found: 280.0701. IR (cm^{-1}): 3336.5, 2922.15, 1415.45, 1709.80, 1599.59, 1506.06, 1476.15, 1308.18, 1238.20, 1185.20, 1185.70, 1183.70, 1106.92, 1013.09, 898.69, 829.14, 756.56, 674.77. Elemental analysis calcd. for $C_{13}H_{10}F_3N_3O$: C 55.52; H, 3.58; N, 14.94; Found: C, 55.43; H, 3.35; N, 14.94. Melting point: 231.7-232.3 °C.

Characterisation of 3-pyridyl urea analogues, 5-8.

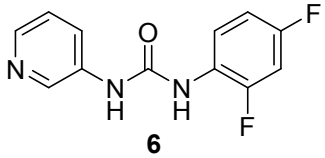


5

1-(4-fluorophenyl)-3-(pyridin-3-yl)urea, 5:

White crystalline needles were obtained in hot methanol/acetonitrile (1:1).

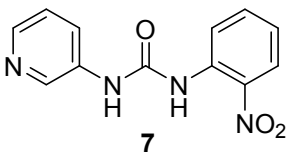
Yield = 101 mg (68%). ^{1}H NMR (400 MHz, DMSO-d_6): 8.84 (s, 2H), 8.62 (d, 1H, J=4Hz), 8.20 (dd, J=4Hz), 7.93-7.96 (m, 1H), 7.50-7.47 (m, 2H), 7.33-7.20 (1H, q, J=12Hz), 7.17-7.11 (m, 2H). ^{13}C NMR (100 MHz, DMSO-d_6, ^{19}F-coupling included): 159.16, 156.79, 153.15, 143.55, 140.61, 136.87, 136.23, 136.21, 125.68, 124.04, 120.75, 120.67, 115.88, 115.66. IR (cm^{-1}): 3340.0, 3062.89, 1714.6, 1542.1, 1506.9, 1473.8, 1416.9, 1324.2, 1283.0, 1252.8, 1196.8, 1133.3, 1105.7, 1057.2, 902.7, 765.0, 730.43. HRMS calcd. for $C_{12}H_{11}N_3OF$ = 232.0886; Found mass =232.0888. Elemental analysis calcd. for $C_{12}H_{10}FN_3O$: C, 62.22; H, 4.31; N, 18.15; Found: C, 62.33; H, 4.36; N, 18.17. Melting point: 196.8- 197.2˚C.



6

1-(2,4-difluorophenyl)-3-(pyridin-3-yl)urea, 6:

White colored crystalline needles were obtained in hot methanol. Yield = 223 mg (91%). ^{1}H NMR (400 MHz, DMSO-d_6): 9.19 (s, 1H), 8.62 (d, 1H, J = 16.3 Hz), 8.21 (d, 1H, J = 4 Hz), 7.74 (t, 2H, J = 15.6 Hz), 7.08 (t, 2H, J = 16.9 Hz), **7**.01-7.03 (m, 2H). ^{13}C NMR (100 MHz, DMSO-d_6, ^{19}F-coupling included): 158.18, 155.78, 153.66, 153.53, 152.38, 151.22, 151.10, 143.09, 139.92, 136.15, 125.05, 123.83, 123.68, 122.36, 122.27, 111.18, 110.97, 104.10, 103.87, 103.84, 103.57. IR (cm^{-1}): 3290.9, 3074.9, 1721.5, 1595.8, 1548.0, 1419.6, 1282.55, 1193.2, 1095.9, 959.9, 835.82, 802.8, 697.9. Elemental analysis calcd. for $C_{12}H_9F_2N_3O$: C, 57.83; H, 3.64; N, 16.86; Found: C, 57.76; H, 3.53; N, 16.92; HRMS calcd. for $C_{12}H_9F_2N_3O$ = 250.0792. Found mass =250.0794. Melting point: 208.5 – 208.9˚C.



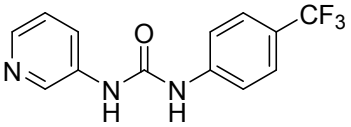
7

1-(2-nitrophenyl)-3-(pyridin-3-yl)urea, 7:

Yellow crystalline needles obtained by slow evaporation of toluene/acetonitrile (2/8). Yield: 292 mg, 99.4%. ^{1}H NMR (400 MHz, DMSO-d_6): 9.94 (s, 1H), 9.76 (s, 1H), 8.65 (d, 1H, 2.4Hz), 8.29 (dd, 1H, J = 8.4 Hz) , 8.24 (dd, 1H, J = 4.7 Hz), 8.11 (dd, 1H, J = 8.4 Hz), 7.47-7.70 (m, 1H), 7.37-7.33 (m, 1H), 7.26-7.22 (m, 1H). ^{13}C NMR (100 MHz, DMSO-d_6): 152.45, 143.95, 140.73, 138.36, 136.47, 135.48, 134.99, 125.97, 125.89, 124.18, 123.14,

123.05. IR (cm^{-1}): 3348.0, 2920.0, 2846.7, 1718.1, 1581.3, 1475.1, 1495.2, 1455.65, 1429.3, 1343.0, 1268.5, 1201.7, 1131.0, 858.2, 809.6, 779.5, 736.3, 707.0. HRMS calcd. for $C_{12}H_{11}N_4O_3$: 259.0831, Found: 259.0832. Elemental analysis calcd. for $C_{12}H_{10}N_4O_3$: C, 55.81; H, 3.90; N, 21.70. Found: C, 55.70; H, 3.89, N, 22.02. Melting point: 238.1 – 238.3 °C.

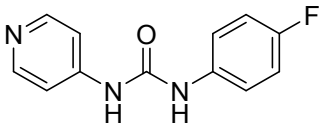
1-(pyridin-3-yl)-3-(4-(trifluoromethyl)phenyl)urea, 8:



8

Crystals. Yield: 230 mg (77%). ^{1}H NMR (400MHz, DMSO-d_6): 9.26 (s, 1H), 9.00 (s, 1H), 8.63 (d, 1H, J = 4Hz), 8.22 (d, 1H, J = 4Hz), 7.96 (d, 1H, J = 8Hz), 7.65 (q, 4H, J = 8Hz), 7.33 (dd, 1H, J = 4Hz). ^{13}C NMR (100MHz, DMSO-d_6): 152.38, 143.23, 140.30, 136.05, 126.13, 126.10, 125.87, 125.46, 123.64, 123.18, 122.14, 121.82, 118.02. IR (cm^{-1}): 3315.8, 2932.32, 1710.56, 1512.69, 1506.14, 1415.48, 1310.02, 1236.19, 1186.78, 1107.41, 1070.13, 831.31, 790.17, 655.15. HRMS calcd. for $C_{13}H_{10}F_3N_3O$: 280.0698; Found: 280.0697. Elemental analysis calcd. for $C_{13}H_{10}F_3N_3O$: C,55.52, H, 3.58, N, 14.94; Found: C,55.56, H, 3.32, N, 14.78. Melting point: 208.6 – 209.1 °C.

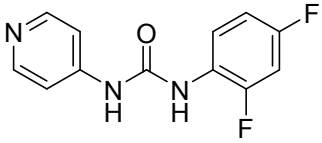
Characterisation of 4-pyridyl urea analogues 10-12.



9

9: Compound **9** was prepared according to literature.[1]

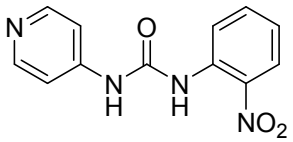
1-(2,4-difluorophenyl)-3-(pyridin-4-yl)urea, 10:



10

Yield: Amorphous powder. 186 mg (70.2 %). ^{1}H NMR (400 MHz, DMSO): 9.39 (d, *J* = 41.8 Hz, 1H), 8.70 (s, 1H), 8.38 (d, *J* = 5.5 Hz, 2H), 8.04 (td, *J* = 9.2, 6.2 Hz, 1H), 7.45 (t, *J* = 7.5 Hz, 2H), 7.34 (ddd, *J* = 11.6, 8.9, 2.9 Hz, 1H), 7.12 – 7.03 (m, 1H), 7.16 – 6.99 (m, 1H). ^{13}C NMR (100 MHz, DMSO, ^{19}F-coupling included): 158.66, 158.55, 158.54, 158.37, 156.27, 156.13, 156.12, 156.01, 153.9, 153.83, 153.8, 153.66, 152.00, 151.47, 151.4, 151.35, 151.30, 150.19, 146.28, 123.46, 122.62, 112.56, 112.27, 111.16, 111.04, 110.80, 104.20, 103.96, 103.93, 103.70. IR (cm^{-1}): 3304.05, 2927.8, 1711.85, 1735.94, 1595.16, 1501.10, 1421.15, 1329.50, 1180.20, 1093.81, 1034.48, 996.85, 958.34, 837.27, 814.92, 722.90, 655.05, 512.43. HRMS calcd. for $C_{12}H_8F_2N_3O$: 248.0635, Found:

248.0643. Elemental analysis calcd. for $C_{12}H_9F_2N_3O$: C,57.83, H, 3.64, N, 16.86; Found: C,57.47, H, 3.47, N, 16.97. Melting point: 211.1-211.9˚C.

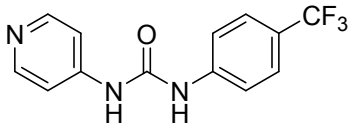


11

1-(2-nitrophenyl)-3-(pyridin-4-yl)urea, 11:

Yield: 245 mg (89%). ^{1}H NMR (400 MHz, DMSO): 10.23 (s, 1H), 9.69 (s, 1H), 8.39 (s, 2H), 8.32 – 8.02 (m, 2H), 7.72 (t, *J* = 7 Hz, 1H), 7.46 (d, *J* = 4 Hz, 2H), 7.25 (t, *J* = 7.7 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6): δ 151.69, 150.29, 146.10, 138.21, 134.97, 134.05, 125.42, 122.90,112.52. IR (cm^{-1}): 3322.0, 1729.27, 1599.31, 1498.06, 1419.68, 1189.34, 998.38, 815.82, 736.84, 630.89. HRMS calcd. for $C_{12}H_9N_4O_3$: 257.0675, Found: 257.0685. Elemental analysis calcd. for $C_{12}H_9N_4O_3$: C, 55.81, H, 3.90, N, 21.90; Found: C, 55.71, H, 3.74, N, 21.71. Melting point: 205.4-205.7˚C.

1-(pyridin-4-yl)-3-(4-(trifluoromethyl)phenyl)urea, 12:



12

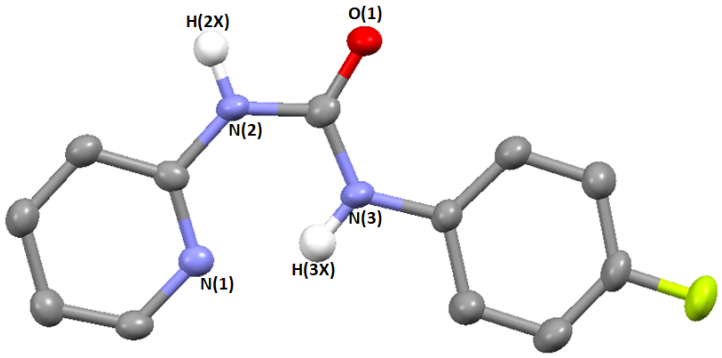
Yield: 245mg (82.01%). ^{1}H NMR (400 MHz, DMSO-d_6): δ 9.31 (s, 1H), 9.26 (s, 1H), 8.39 (d, *J* = 6.0 Hz, 2H), 7.74 – 7.57 (m, 4H), 7.47 (dd, *J* = 4.9, 1.5 Hz, 2H). ^{13}C NMR (100 MHz, DMSO-d_6): δ 151.96, 150.20, 146.24, 142.89, 126.05, 126.05, 125.84, 123.15, 123.00 – 122.77, 122.54, 122.22, 122.01, 121.67, 118.25, 112.48. IR (cm^{-1}): 3301.30, 2923.6, 1711.30, 1736.11, 1505.99, 1592.64, 1420.66, 1329.41, 1295.45, 1182.93, 1094.12, 1034.11, 1064.60, 996.40, 656.36. HRMS calcd. for $C_{13}H_{19}F_3N_3O$: 280.0698, Found: 280.0688. Elemental analysis calcd. for $C_{13}H_{10}F_3N_3O$: C, 55.82, H, 3.58, N, 14.94; Found: C, 55.45, H, 3.37, N, 15.13. Melting point: 223.3-224.0˚C.

2: X-ray studies of Pyridyl urea analogues

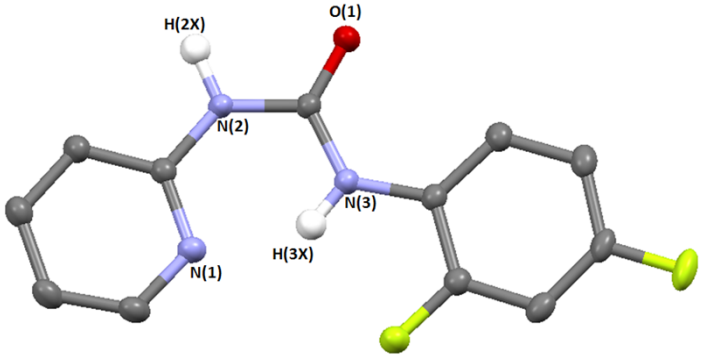
2.1 Crystal structures of 2-pyridyl urea analogues

Analogues **1-4** were recrystallised from acetonitrile/methanol solvents. Hot solutions of **1-4** on slow evaporation at room temperature yielded X-ray quality single crystals of **1-4**. Crystallisation of **4** was attempted in various solvent combination and yield twined crystals/ fibres which were not suitable for single crystal diffraction analysis. Crystal structures of **1-3** are shown below.

a)



b)



c)

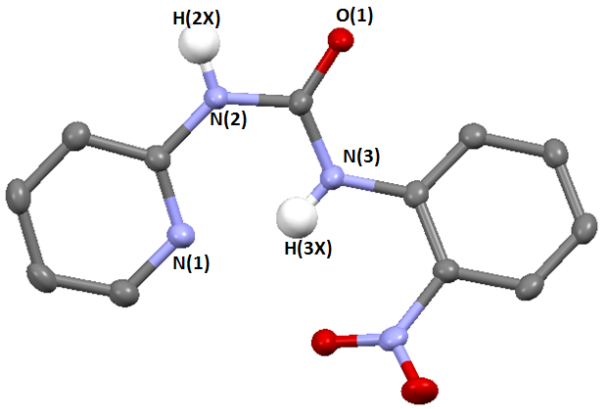
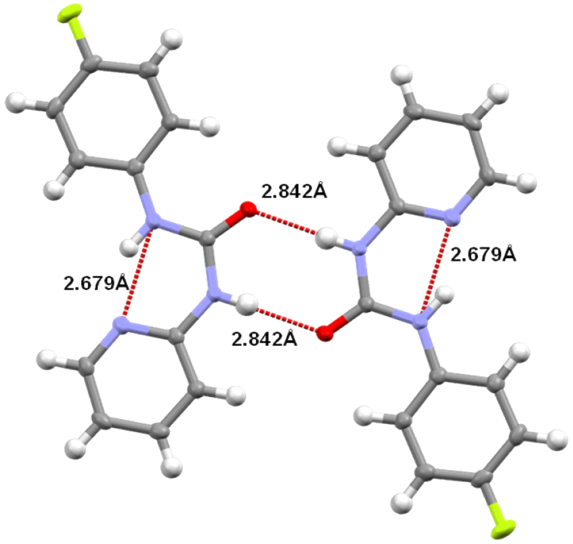


Fig. S1 (a-c): Crystal structure of **1**, **2**, and **3**. (urea motif adopts *anti*- conformation).

2.1.1 Hydrogen bonding interactions in 1-3

a)



b)

b)

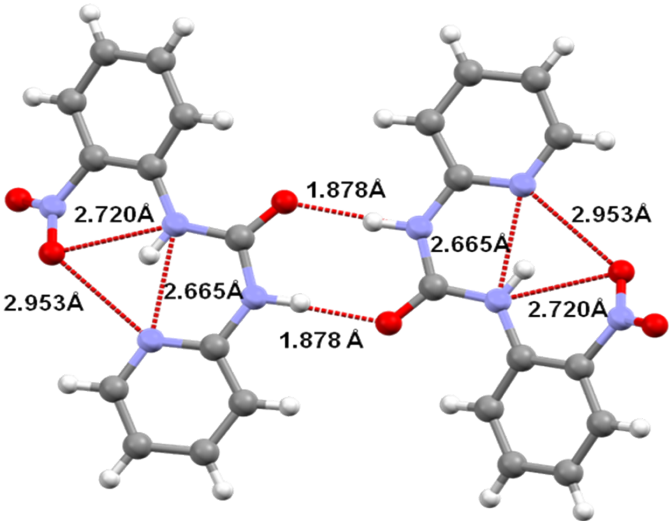
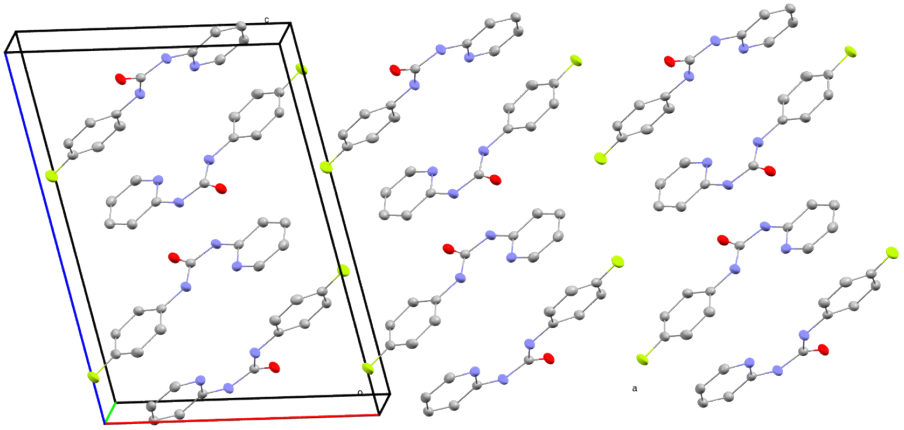


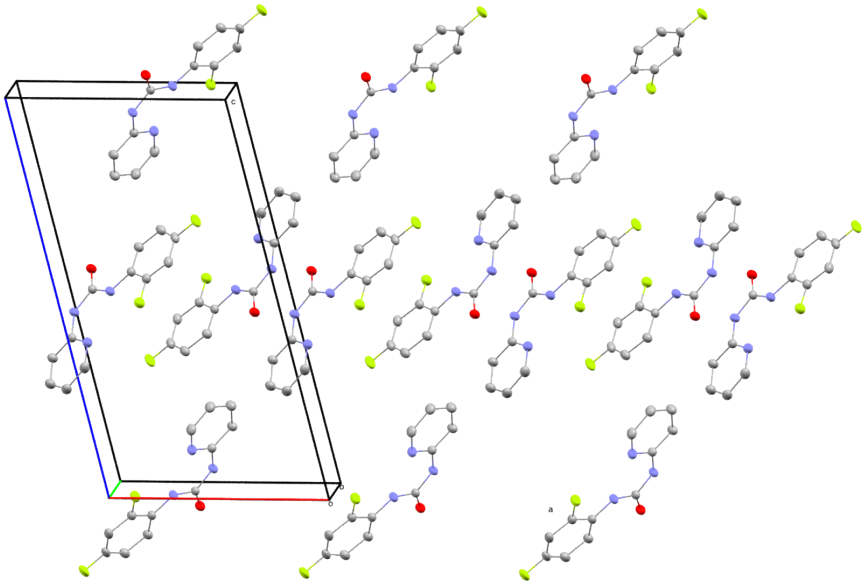
Fig. S2 (a-b): Centrosymmetric solid state dimeric structures due to intermolecular hydrogen bonding in **1-3.**

2.1.2. Packing diagram of 1-3

a)



b)



c)

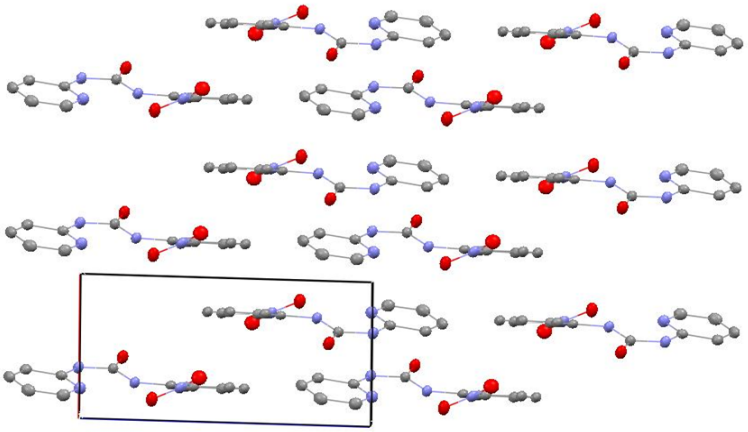
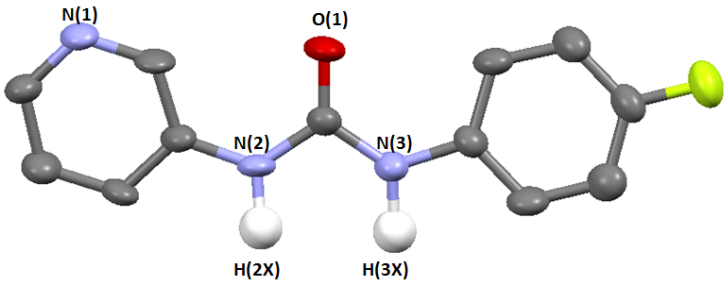


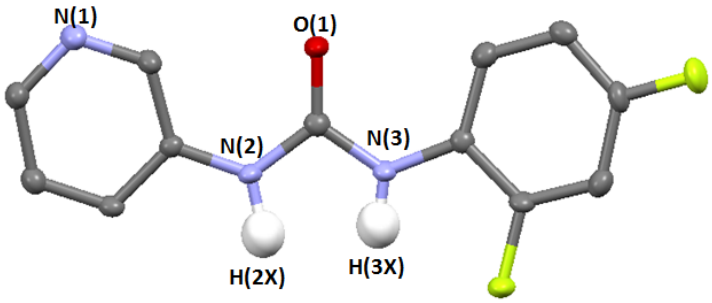
Fig . S3 (**a-c**): Packing interactions of molecules in **1-3**.

2.2 Crystal structures of 3-pyridyl ureas 5-7.

a)



b)



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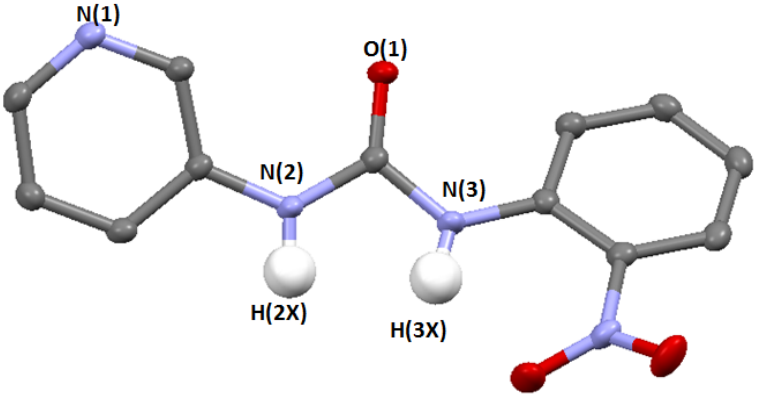
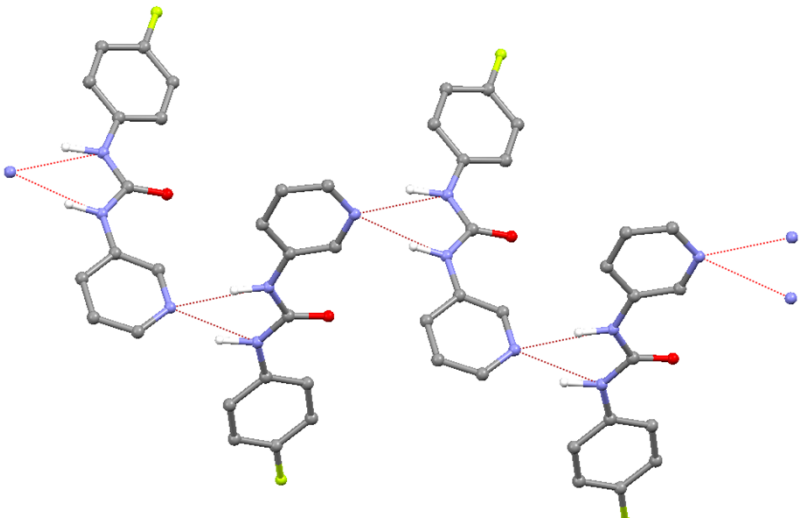


Fig. S4 (a-c): Crystal structure of **5**, **6** and **7**. (urea motif adopts *syn*-conformation).

2.2.1 Hydrogen bonding interactions in 5-7

a)



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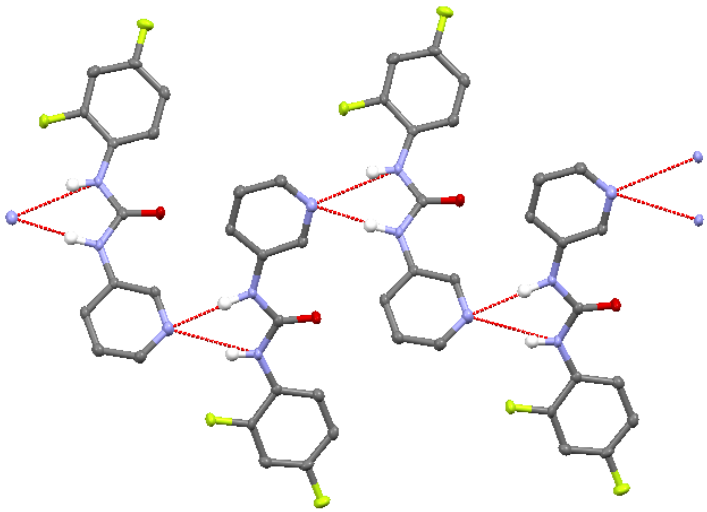


c)

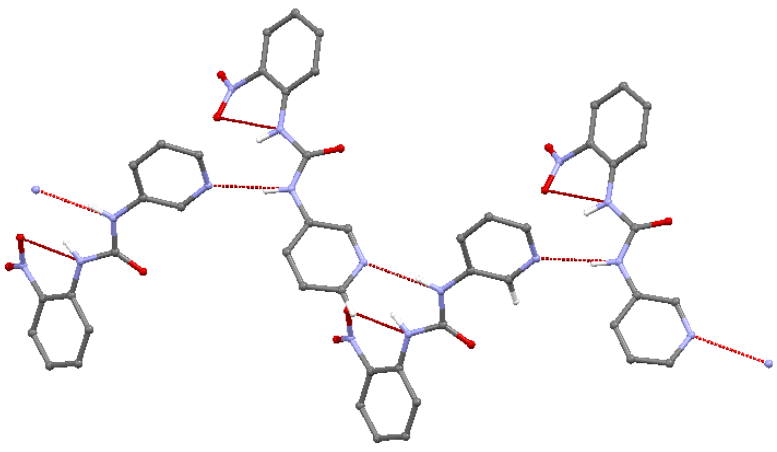
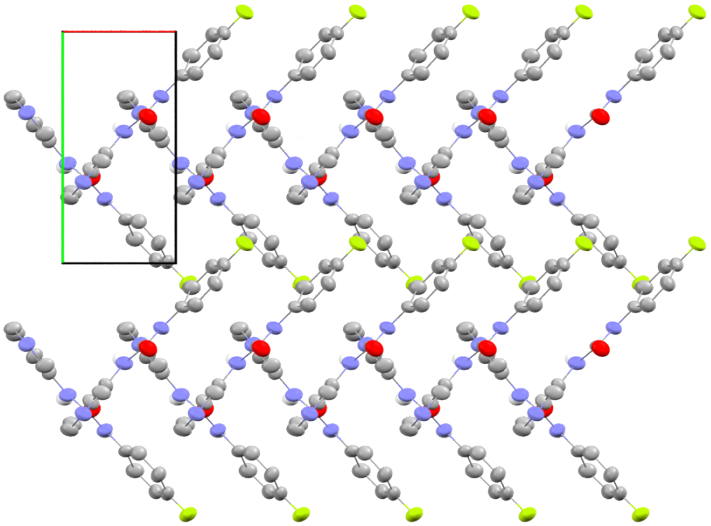


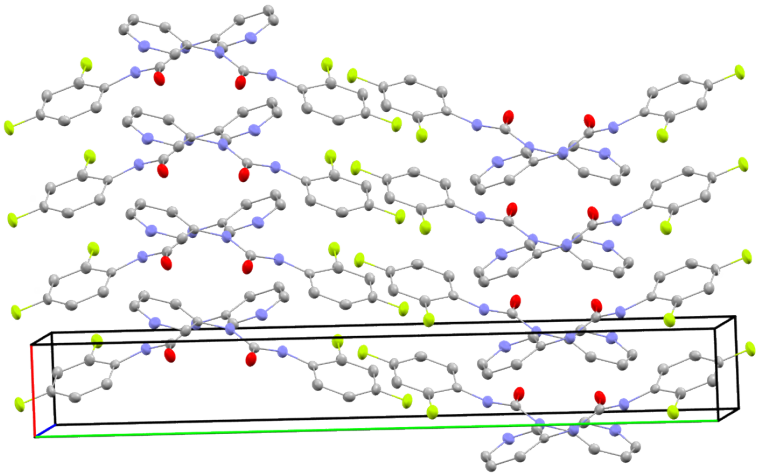
Fig. S5 (a-c): Hydrogen bonded polymers of **4-6** (All the three analogues forms pyridyl tape motif)

2.2.2. Packing diagram of 5-7

a)



b)



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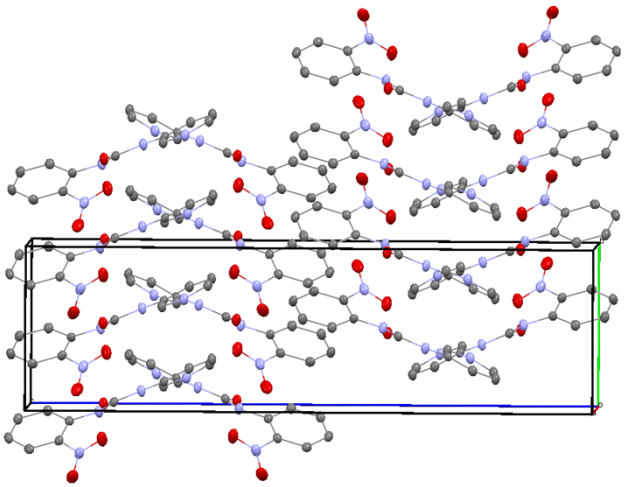
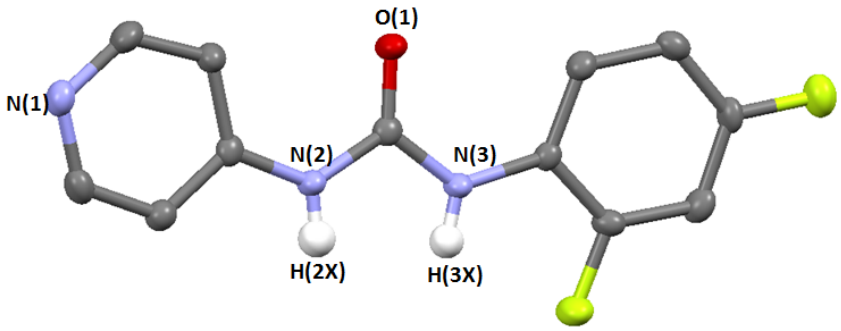


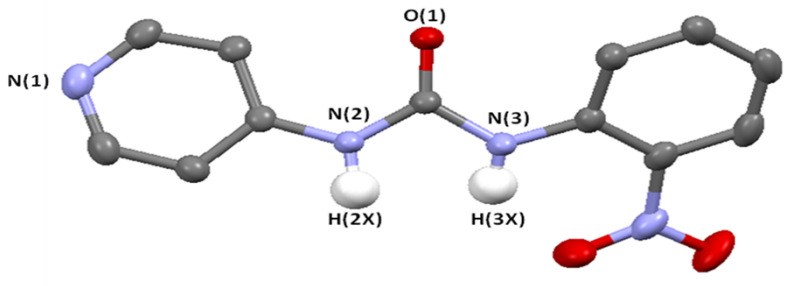
Fig S6. Packing of structures **5-7.**

2.3 Crystal structures of 4-pyridyl urea analogues

a)



b)



c)

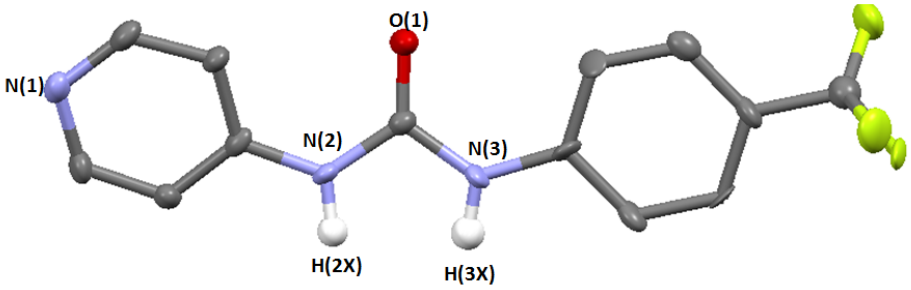
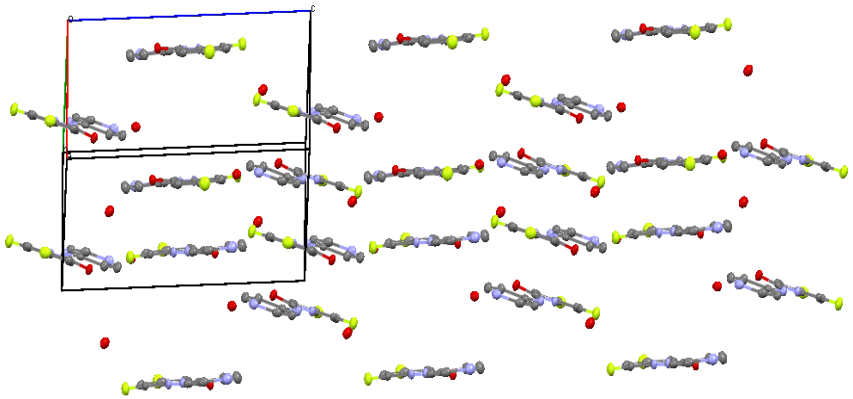


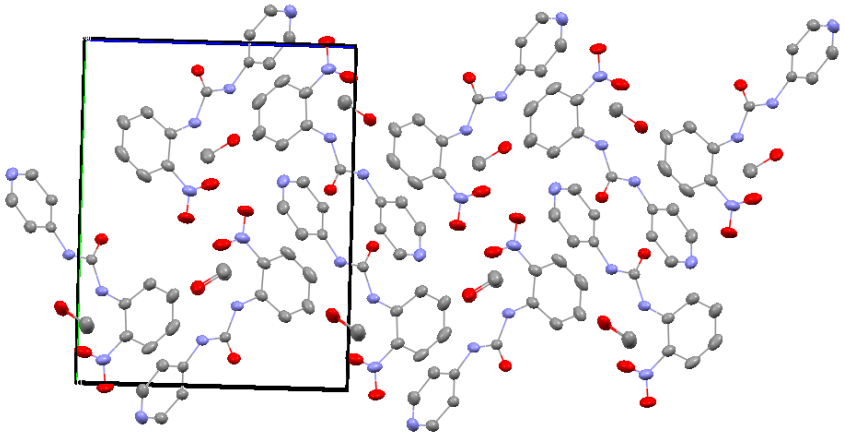
Fig. S7 (a - c): Crystal structure of **10- 12. (**Disorder of CF_3 in **12 is** not shown for clarity**).**

2.3.1: Packing diagram of 10-12

a)



b)



c)

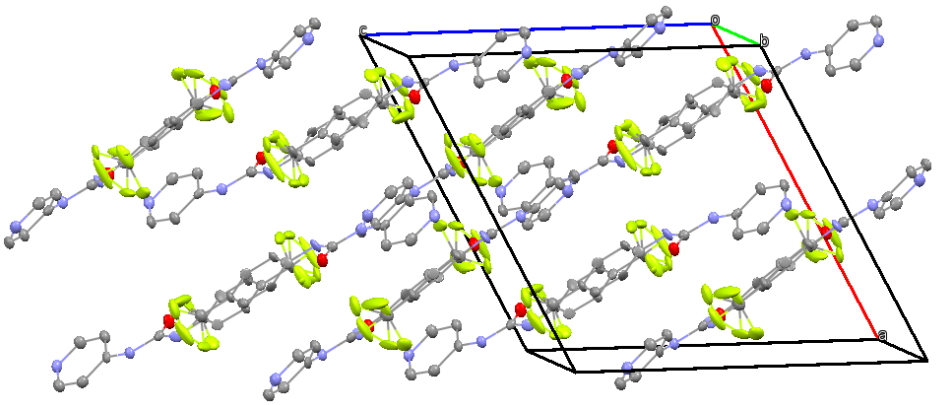
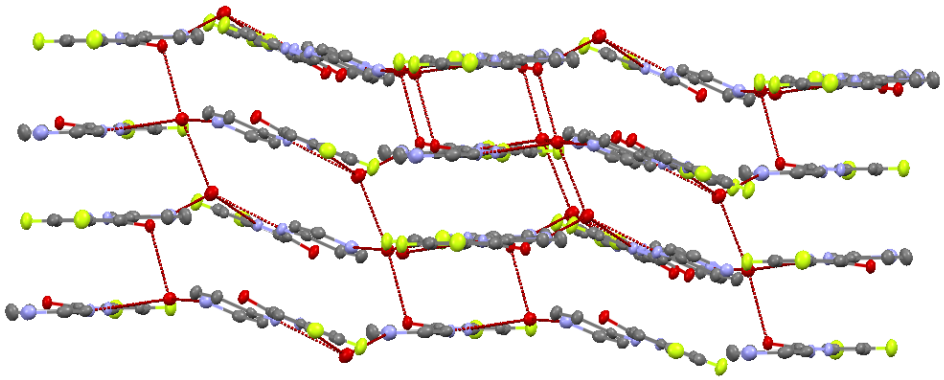


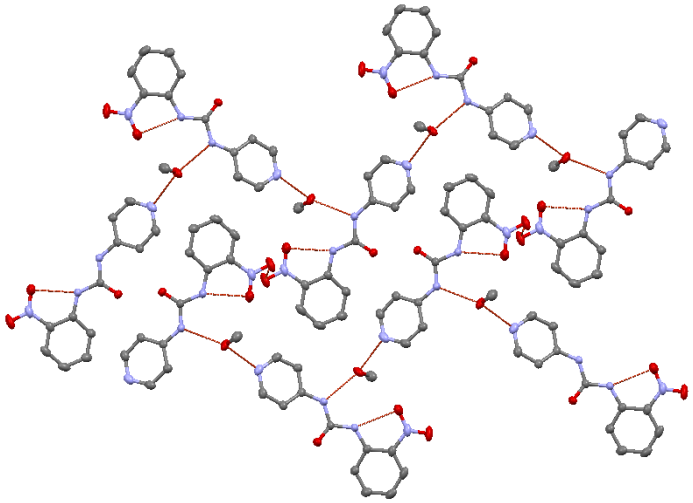
Fig. S8 (a-c) Packing for structures **10- 12.**

2.3.2 Hydrogen bonding interactions in 10-12

a)



b)



c)

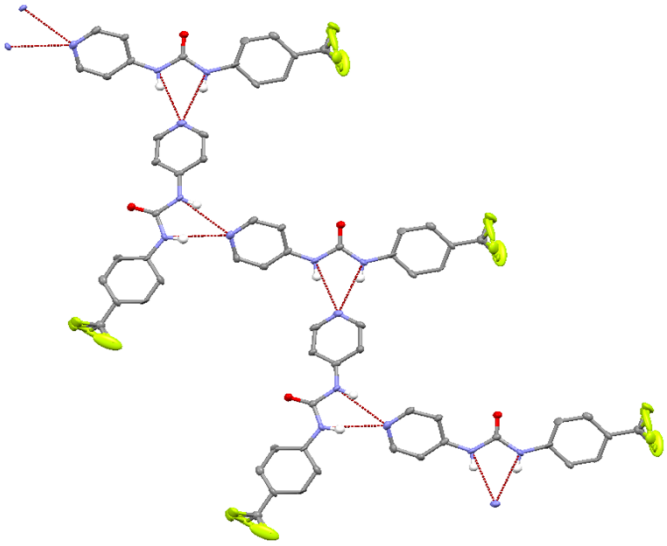


Fig. S9: Hydrogen bonding interactions in 10-**12.**

Table 1: Hydrogen bonding parameters of 1-3, 5-7 and 10-12.

Ureas	D-H...A	d(H...A)	d(D...A)	<(DHA)
1 [a]	N(2)- (2X)...O(1)#1 N(3)-H(3X)...N(1)	2.02 1.92	2.840(2) 2.689(2)	176.0 143.8
2 [b]	N(2)-H(2X)...O(1)#1 N(3)-H(3X)...N(1)	1.87 1.93	2.842(2) 2.679(3)	168.1 142.0
3[c]	N(2)-H(2X)...O(1)#1 N(3)-H(3X)...N(1) N(3)-H(3X)...O(2)	1.88 1.93 2.11	2.956(3) 2.664(3) 2.720(3)	173.6 140.0 126.0
5 [d]	N(2)-H(2X)...N(1)#1 N(3)-H(3X)...N(1)#1	2.24 2.27	3.042(5) 3.032(5)	151.2 145.8
6 [e]	N(2)-H(2X)...N(1)#1 N(3)-H(3X)...N(1)#1	2.13 2.28	3.045(3) 3.086(3)	157.8 158.5
7[f]	N(2)-H(2X)...N(1)#1 N(3)-H(3X)...O(2)	2.07 2.05	2.9515 2.6544	169 126.6
10[g]	N(2)-H(2B)…O(3) N(3)-H(3)…O(3) N(5)-H(5B)…O4[i] O(4)-H(4A)…N1[ii] O(4)-H(4B)…O3[iii] O(3)-H(3A)…N4[iv] O(3)-H(3B)…O1[v] N(6)-H(6)…O(4)[i]	2.25(2) 2.22(3) 2.10(3) 1.869(15) 2.22(2) 1.67(3) 2.13(3) 2.23(3)	2.957(2) 2.963(2) 2.882(2) 2.769(3) 3.009(2) 2.709(2) 2.908(2) 3.003(3)	158(2) 155(2) 163(2) 169(2) 152(3) 166(2) 163(3) 157(2)
11[h]	N(2)-H(2X)...O(100) N(3)-H(3X)...O(3) N(3)-H(3X)...O(100) O(100)-H(10X)...N(1)	1.857 2.031 2.537 1.86	2.7648 2.6511 3.1955 2.7148	171.9 130.9 137.0 175
12[i]	N(2)-H(2A)...N(1)[i] N(3)-H(3)...N(1)[i] N(3)-H(3)...F(15)[ii] N(5)-H(5A)...N(4)[iii] N(6)-H(6) ...N(4)[iii] N(6)-H(6) ...F(12)[iv]	2.28 2.31 2.56 2.27 2.28 2.55	3.100 3.101 3.195 3.098 3.081 3.142	155 149 130 156 151 126

Symmetry operation used: **a**, #1 −*x*+1, −*y*+2, −*z* : **b**, #1 −*x*+1, −*y*, −*z*+2 : **c**, #1 −*x*+1, −*y*, −*z*, **d**, #1 *x*−1/2, −*y*−1, *z*−1/2, #1 *x*, −*y*+3/2, *z*−1/2, #1 −*x*+1, −*y*+1, −*z* , **e,** *x*, *y*−1, *z* , **f** , #1 −*x*, *y*+1/2, −*z*+3/2 , **g**, (i) 1–*x*, 1−*y*, −*z*; (ii) *x*+1, *y*, *z*; (iii) 1−*x*, 1−*y*, 1−*z*; (iv) *x*, 1−*y*, 1−*z*; (v) –*x*, −*y*, 1−*z*; **h**, #1 *x*−1/2,*y*, −*z*+1/2. **i**,(i) −*x*, *y*−1/2, −*z*−1/2; (ii) −*x*, −*y*+1, −*z*; (iii) −*x*+1, *y*+1/2, −*z*+3/2; (iv) −*x*+1, −*y*+1, −*z*+1.

Table T2: Crystal structure data for pyridyl urea analogues 1-3, 5-7 and 10-12.

	1	**2**	**3**	**5**	**6**	**7**	**10**	**11**	**12**
Temperature	108(2) K	108(2) K	119(2) **K**	108(2) K	108(2) K	107(2) K	100(2)K	162(2) K	100(2)
Formula	$C_{12}H_{10}FN_3O$	$C_{12}H_9F_2N_3O$	$C_{12}H_{10}N_4O_3$	$C_{12}H_{10}FN_3O$	$C_{12}H_9F_2N_3O$	$C_{12}H_{10}N_4O_3$	$C_{12}H_{11}F_2N_3O_2$	$C_{13}H_{14}N_4O_4$	$C_{13}H_{10}F_3N_3O$
Molecular weight	231.23	249.22	258.24	231.23	249.22	258.24	267.24	290.28	281.24
Crystal size (mm)	0.47×0.28×0.24	0.54×0.32×0.22	0.33×0.31×0.19	0.43×0.32×0.22	0.35×0.24×0.21	0.45×0.08×0.08	0.20×0.07×0.05	0.44×0.32×0.31	0.29×0.22×0.20
Crystal system	Monoclinic	Monoclinic	Triclinic	Monoclinic	Monoclinic	Orthorhombic	Triclinic	Monoclinic	Monoclinic
Space group	P2(1)/c	P2(1)/n	P−1	Pn	P2(1)/c	Pbca	P −1	P2(1)/c	P2(1)/c
a, b, c (Å)	*a* = 11.785(2) *b* = 5.7638(12) *c* = 16.482(3)	*a* = 10.484(2) *b* = 5.4019(11) *c* = 19.491(4)	*a* = 6.9066(14) *b* = 7.9420(16) *c* = 11.370(2)	*a* = 4.5349(9) *b* = 11.591(2) c = 10.686(2)	*a* = 3.7683(8) *b* = 27.238(5) *c* = 10.409(2)	*a* = 11.9799(18) *b* = 7.3695(13) *c* = 25.427(4)	*a* = 8.9104(3) *b* = 9.9683(3) *c* = 13.1855(4)	*a* = 8.1756(16) *b* = 14.365(3) *c* = 11.375(2)	*a* = 14.5029(12) *b* = 12.7130(11) *c* = 14.3436(12)
α, β, γ (°)	*α* = 90 *β* = 100.42(3) *γ* = 90	*α* = 90 *β*= 104.37(3) *γ* = 90	*α* = 81.16(3) *β* = 87.98(3) *γ* = 67.14(3)	*α* = 90 *β*= 98.22(3) *γ* = 90	*α* = 90 *β*= 97.29(3) γ = 90	*α* = 90 *β*= 90 *γ* = 90	*α*=91.865(2) *β*=92.788(2) *γ* =91.591(2)	*α* = 90 *β*= 92.01(3) *γ* = 90	*α*= 90 *β*= 116.799(2) *γ* = 90
Volume (Å^3)	1093.2(4)	1069.3(4)	567.6(2)	555.92(19)	1059.8(4)	2244.9(6)	1168.65(6)	1335.1(5)	2360.6
Z	4	4	2	2	4	8	4	4	8
d_{calc} (g/cm^3)	1.405	1.548	1.511	1.381	1.562	1.528	1.519	1.444	1.583
μ (mm^{-1})	0.105	0.126	0.113	0.103	0.128	0.958	0.127	0.110	0.14
F(000)	480	512	268	240	512	1072	552	608	1152
Collected reflns	8361	8257	5674	3968	3838	6614	80707	10627	50210
Independent reflns	1889 [R(int) = 0.0208]	1863 [R(int) = 0.0224]	1686 [R(int) = 0.0379]	1763 [R(int) = 0.0353]	1813 [R(int) = 0.0300]	1819 [R(int) = 0.0445]	5368 [R(int)= 0.1195]	2328 [R(int) = 0.0172]	5363 [R(int) = 0.059]
Goodness-of-fit on F^2	1.156	1.199	1.241	1.123	1.236	1.092	1.024	1.063	1.25
R_1 [I>2σ(I)]	*R*1 = 0.036, *wR*2 = 0.1451	*R*1 = 0.0490 *wR*2 = 0.1810	*R*1 = 0.0517 *wR*2 = 0.1614	*R*1 = 0.0678, *wR*2 = 0.1725	*R*1 = 0.0551, *wR*2 = 0.1602	*R*1 = 0.0354, *wR*2 = 0.0875	*R*1=0.0485 *wR*2=0.1131	*R*1 = 0.0353, *wR*2 = 0.0918	*R*1 = 0.074, *wR*2 = 0.2098

3.0 Gelation studies of 1, 6 and 7

3.1: Gelation procedure

Gels were prepared by dissolving 1% wt of pyridyl ureas in 1mL of solvent. Solvents were heated to boiling temperature for 3-4 mins followed by sonication for 3- 4 mins. Gels were formed by slow cooling of the sonicated solution after period of time, Table T3.

Metal assisted gels were synthesised by doping 1% wt of silver nitrate and 1% wt of pyridyl urea in 1mL of THF/H_2O (8:2). Solvents were heated to 80-90°C for 3-4 mins followed by sonication for 5-10 mins. Gels were formed by slow cooling of the sonicated solution after 6-20h.

Pyridyl ureas **1-12** were subjected to gelation studies. 1% wt of pyridyl urea was dissolved in solvents (listed in the table) and heated to solubilise. The solutions were sonicated for 3-4 mins. After period of time, gels were formed in the case of **1, 6** and **7**. Silver gel was obtained only in the case of **1**.

Tabel T3: Gelation conditions used for 1-12

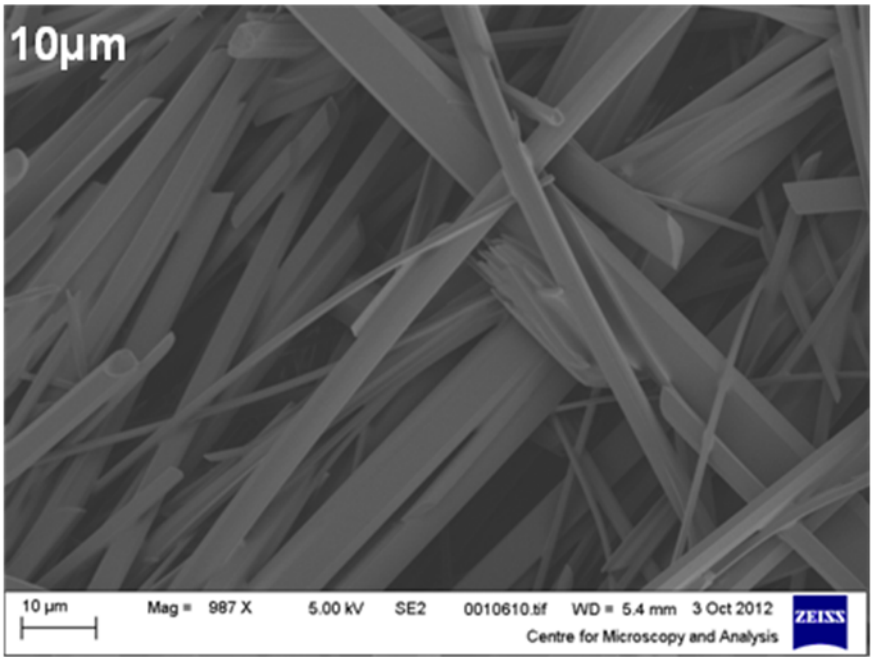
Solvents	1	6	7	1 +$AgNO_3$
Methanol	P	C	S	C
THF	G	P	S	C
THF/H_2O	C	G	G	G
Toluene/THF/$CHCl_3$	G	P	S	P
Toluene	C	C	S	C
THF/$CHCl_3$	S	F	P	P
IPA	F	P	P	GP
IPA/H_2O	P	P	P	GP

IPA- Isopropanol. C-crystals, G-Gel, P-precipitate, , F- fibres, S-solution, GP: Gelatinous precipitate.

3.2: Gel morphological studies

The morphologies of the organogels and hydrogels have been studied by scanning electron microscopic (SEM) techniques.

a)



b)

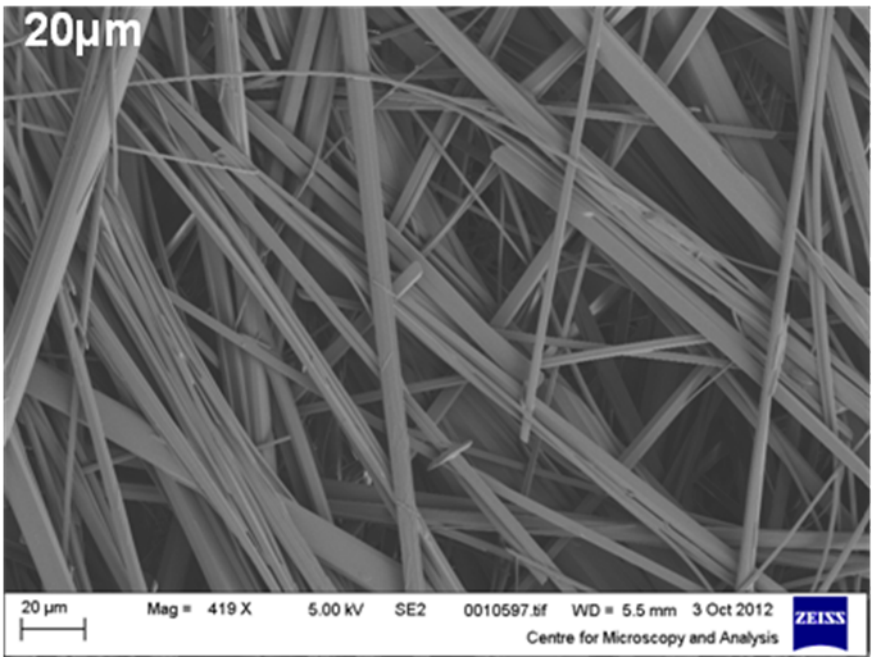
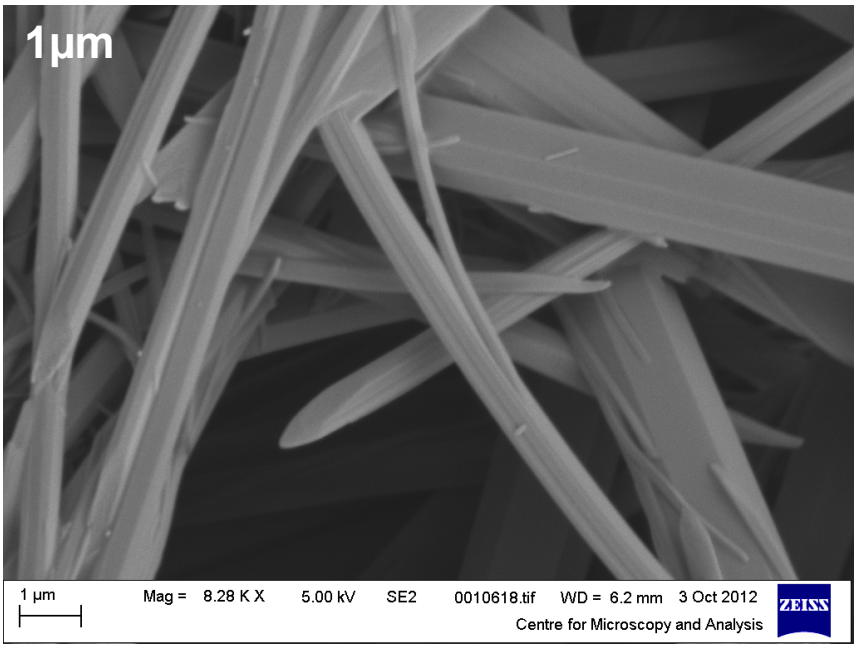


Fig. S10: Organogels of **1** with THF /toluene/$CHCl_3$.

a)



b)

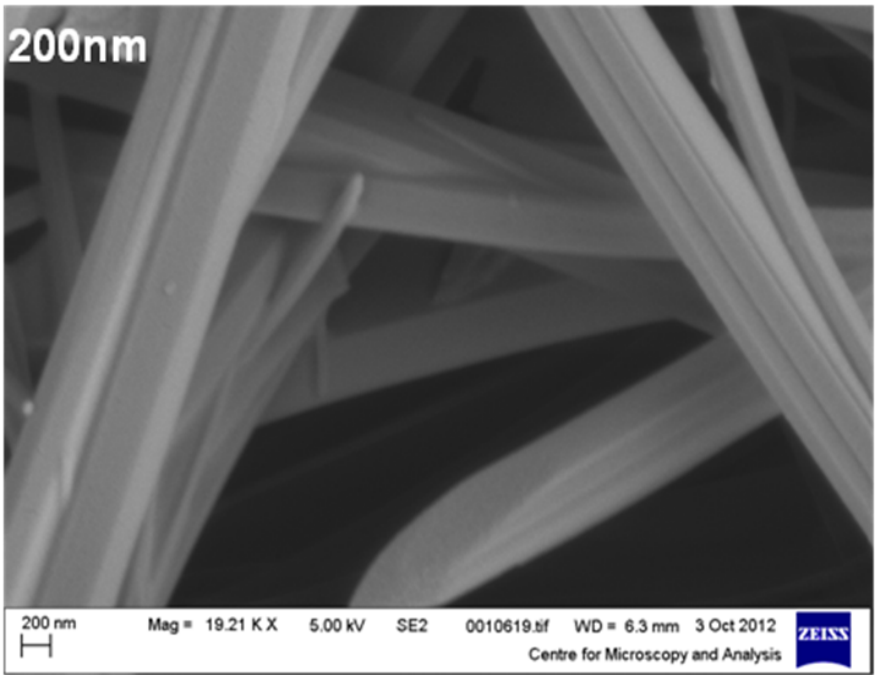
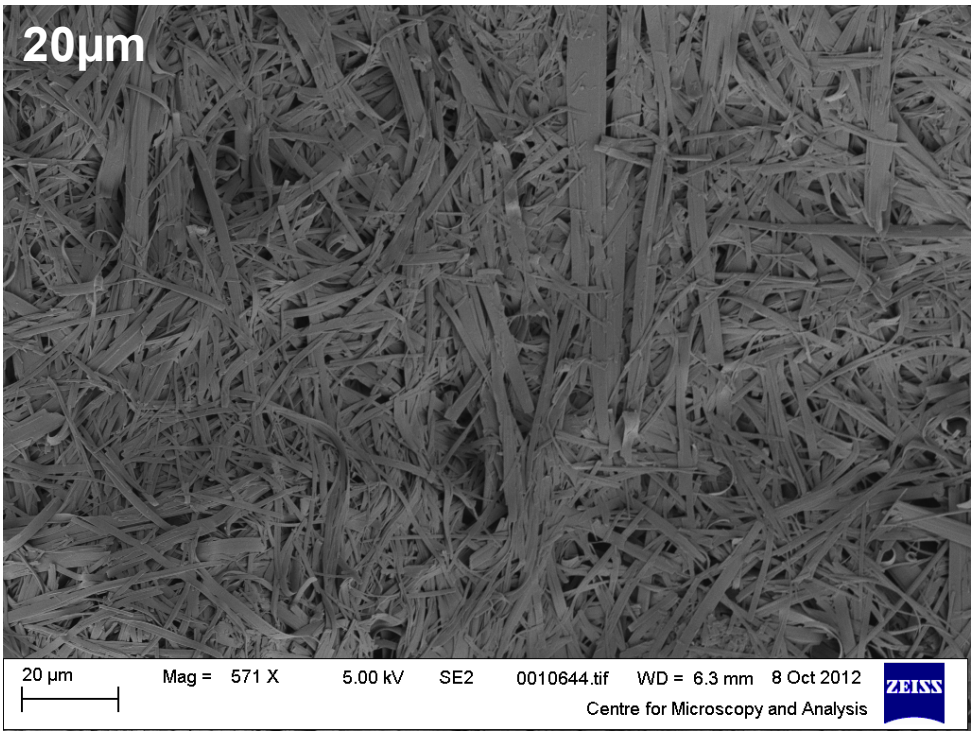


Fig. S11 Organogel of **1** with THF.

a)



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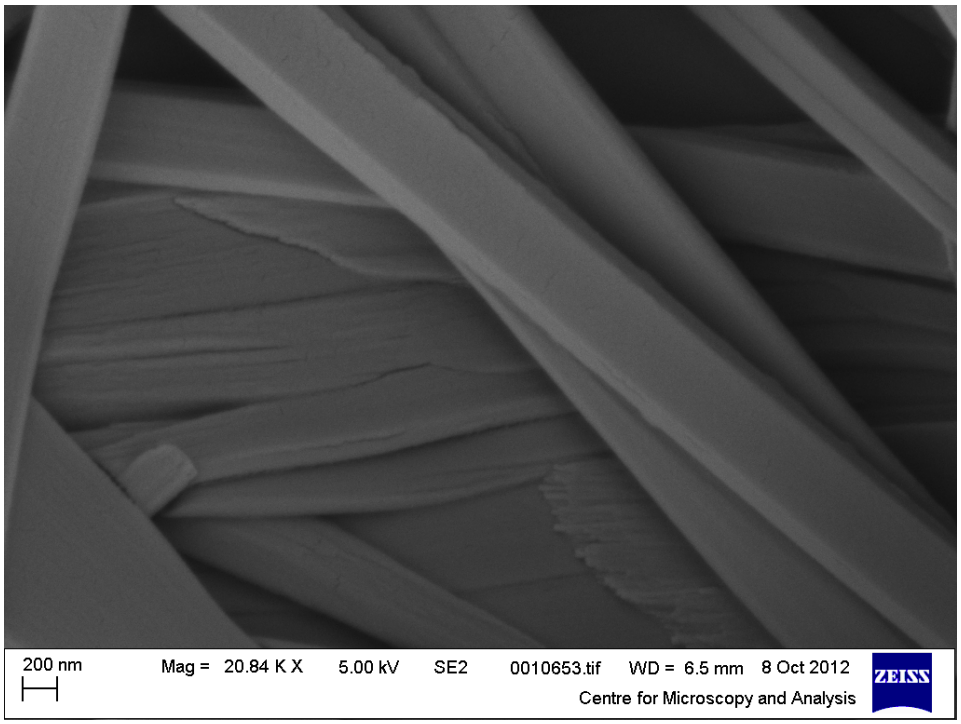


Fig. S12: SEM image of hydrogel of **6** with THF/H_2O.

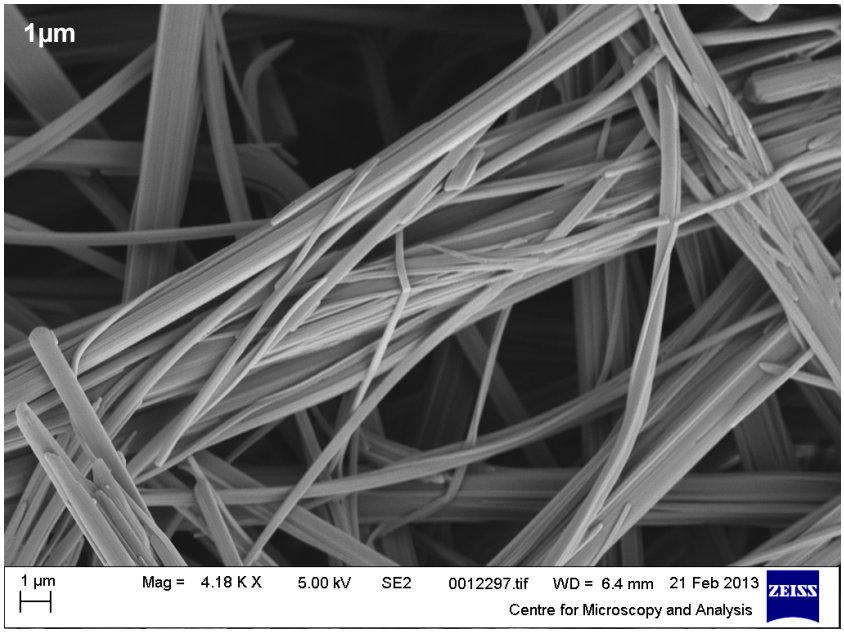


Fig. S13: Metallogel of **1** with $AgNO_3$.

of 1.

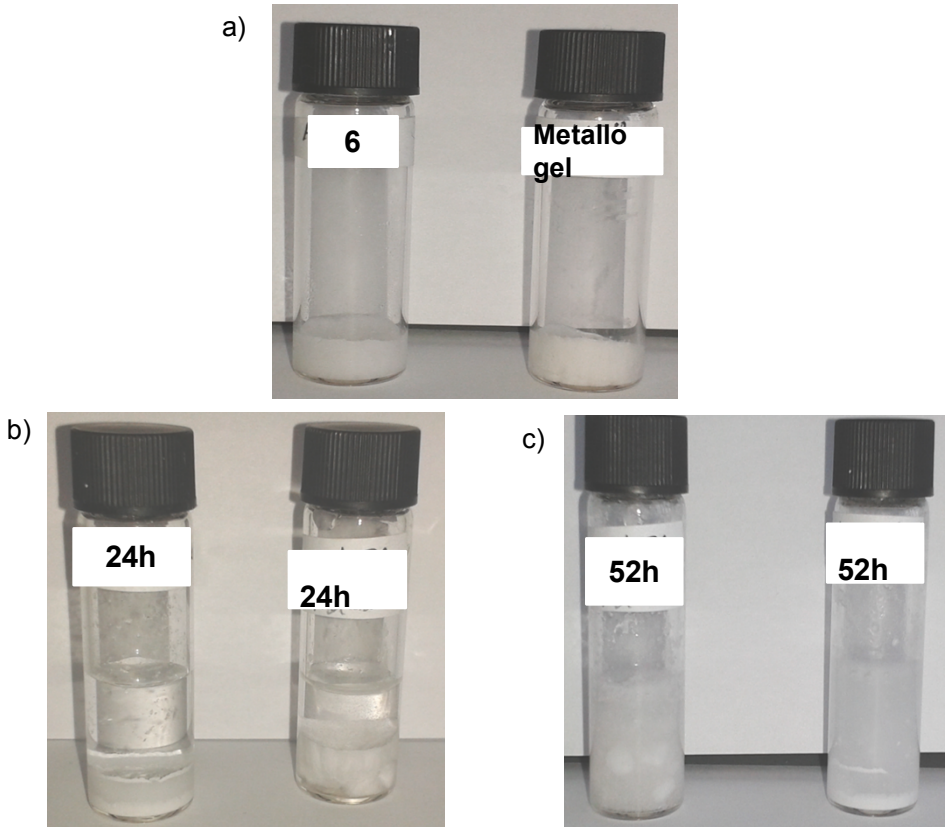
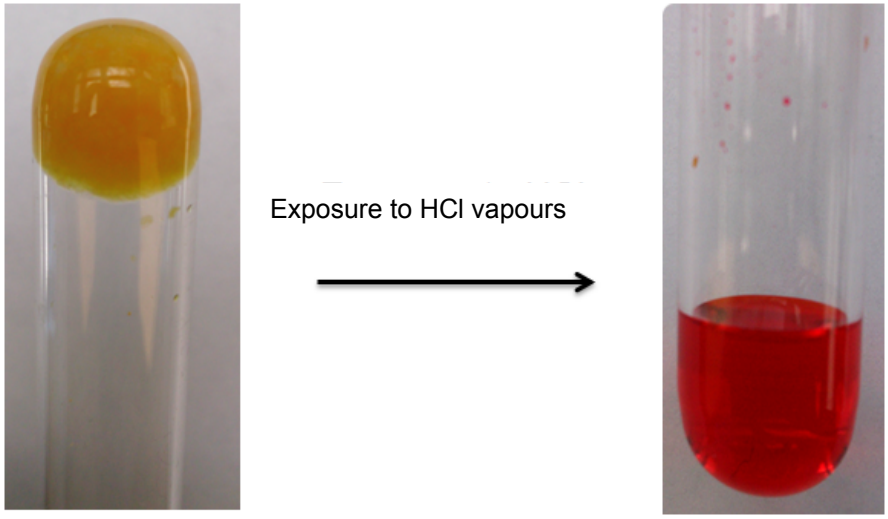


Fig. S14: a) Hydrogels of **6** and **1.AgNO$_3$**. b) Images of gels after 24h treatment with CH_3COONa. Silver gel shows disruption of self assembly by CH_3COONa within the gel. c) Images of gels after 52h, showing the disruption of gel self assembly by CH_3COO Na.

Acid-Base stability test of hydrogels

a)



b)

Fig. S15: a) Hydrogel (with cresol red) of **6** on exposure to HCl vapors disrupts the intermolecular hydrogen bonding thereby disrupts the gel and forms solution; b) Hydrogel (with cresol red) of **6** on exposure to ammonia vapours did not disturb the gel and the gel stays intact.

Antimicrobial activity of pyridyl ureas and gels

Antibacterial activity of compounds **1-12** were assessed and compared towards Gram(+) Methicillin Resistant *S. aureus* (*MRSA*) and Gram(-) *E. coli* were compared using the qualitative Kirby-Bauer disk diffusion method.[1] For comparative purposes compounds **1-12** can be broadly classified according to the position of nitrogen on the pyridine ring as 2-pyridyl, 3-pyridyl and 4-pyridyl ureas.

Kirby-Bauer disk diffusion method

The antibacterial activity of **1-12** were assessed towards Gram(+) *MRSA* (ATTC -43300) and Gram(-) *E. coli* (ATTC -25922) . Both bacterial strains were individually cultured from a single colony in sterile LB medium[2] overnight at 37 °C (orbital shaker incubator). Stock solutions of **1-12** were prepared by dissolving 10mg of the samples in 100 µL of DMSO. 5 µL and 10 µL of stock solutions were used to assess the antibacterial activity of **1-12.** Antibacterial assay was performed under sterile conditions. Overnight cultures of cells of *MRSA* or *E.coli* were uniformly smeared on to Luria broth agar medium in Petri plates. Samples were loaded on sterile discs (5 mm diameter) as DMSO solutions. The plates were then incubated at 37°C for 16-18 h and the zone of clearance (defined as the diameter of inhibited bacterial growth around the filter paper) for each sample was measured in millimetres.

The 2-pyridyl ureas **1, 3** and **4** shows activity against *MRSA* and analogue **1** shows activity against *E.coli,* **T4**. The analogues **2-4** shows no activity against *E.coli*. The 3-pyridyl urea analogues **6** and **7** exhibits activity against *MRSA*. Analogue **8** showed activity towards both the strains whereas analogue **6** and **7** shows activity either against *MRSA* or *E.coli,* **Table T4.**

The 4-Pyridyl urea analogues show better anti-bacterial activity in the series. Analogue **9** shows greatest activity in the series with diameter clearance of 17mm against *MRSA* and 12 mm in the case of *E.coli*. Similarly analogue **12** shows greatest activity against *E.coli* with diameter clearance of 20 mm and comparatively lesser activity against *MRSA*. In contrast to these results analogues **10** and **11** shows no activity either against *MRSA* or *E.coli,* **Table T4.** The photographs of the LB plates with **9 and 10** are shown in **Fig S16**.

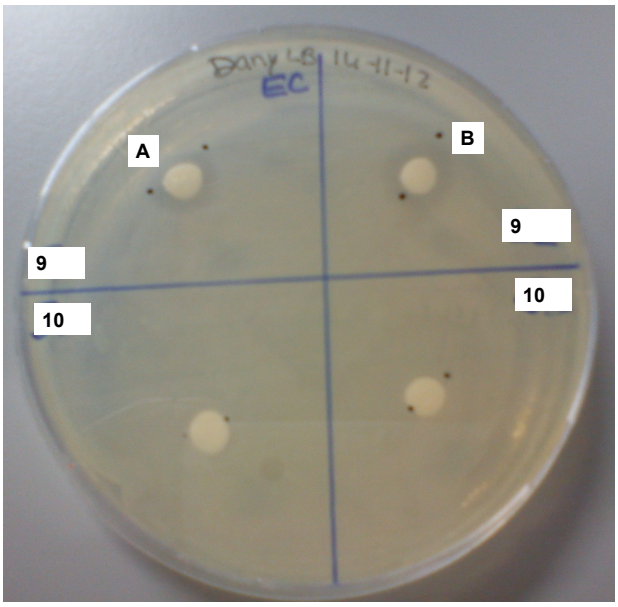
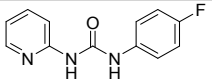
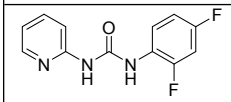
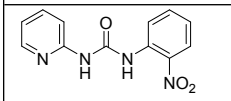
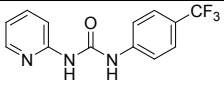
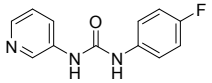
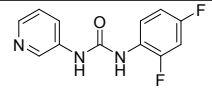
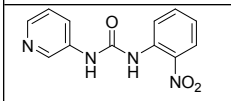
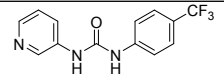
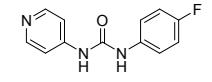
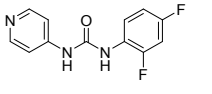
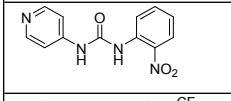
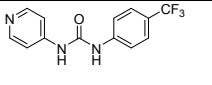


Fig. S16 ;) Activity of **9** and **10** towards Gram(-) *E. Coli,* A) 2.2 µmol, B) 4.4 µmol.

Fig./Scheme XX Caption.

Table T4: Anti-bacterial testing on Gram(+) *MRSA* and Gram(-) *E.coli*

Sample	Gram(+)*MRSA* /diameter of inhibition/amount of sample used in µmol C1 C2		Gram(-) *E.coli* / diameter of inhibition/ amount of sample used in µmol C1 C2	
2-Pyridyl urea analogues				
 **1**	NA	7mm (4.3)	NA	6mm (4.3)
 **2**	NA	NA	NA	NA
 **3**	NA	6mm (3.9)	NA	NA
 **4**	NA	10mm (3.6)	NA	NA
3-Pyridyl urea analogues				
 **5**	NA	NA	NA	NA
 **6**	NA	6mm (4.0)	NA	NA
 **7**	NA	NA	7mm (1.9)	8mm (3.9)
 **8**	NA	7mm (3.6)	7mm (1.8)	7mm (3.6)
4-Pyridyl urea analogues				
 **9**	17mm (2.2)	15mm(4.3)	10mm (2.2)	12mm (4.3)
 **10**	NA	NA	6mm (2.0)	7mm (4.0)
 **11**	6mm (1.9)	7mm (3.9)	NA	NA
 **12[a]**	13mm (1.8)	20mm(3.6)	7mm(1.8)	8mm(3.6)

NA- Not active; C1 -5µL, C2-10 µL. The bacterial assay was performed at 37°C. [a] 2µL of the stock solution used for the study.

Liquid turbidity test against Gram(+) *MRSA* and Gram(-) *E.coli*

Bacterial medium was placed over gels as shown in **Fig S18,** and the sample vials were incubated for 16-18h at 37^0C. After 16-18 h, no growth of bacteria was observed; the gels inhibited the growth of bacteria, **Fig S18**. All the gels exhibit antibacterial activity against both strains. Separately, control experiment was also performed to confirm the antibacterial activity of gels. At zero time the bacterial medium looks transparent and shows no bacterial growth. After 16h control shows intense turbidity showing the growth of bacteria. This proves the anti-bacterial activity of supramolecular hydrogels.

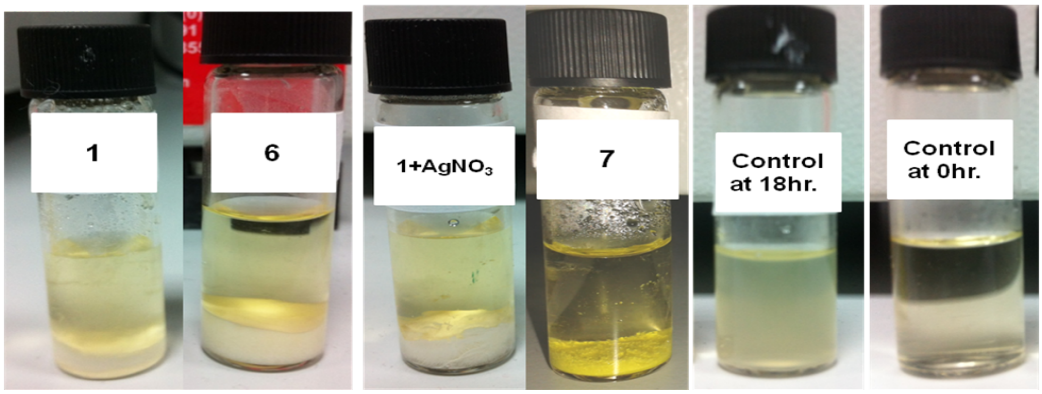


Fig. S18 Liquid turbidity test of gels obtianed from **1**, **6** and **7** against *MRSA*.

Alamar Blue Cell Viability Assay

A suspension of HeLa cells ($2.5 \cdot 10^4$ cells/mL) was incubated in 96 well plates (200µL/well) for 24h at 37ºC. Then 2µL of a dilution of the compound to be tested were added and incubated for additional 24h. Then 20µL of alamarBlue were added, incubated further for 4h and the fluorescence was measured on a Molecular Devices SpectraMAX Gemini fluorimeter (λ_{ex} = 544nm, λ_{em} = 590nm).

For every compound and every concentration, at least three replicates were made. The compounds tested were **1**, **2**, **4**, **5**, **6**, **8**, **9**, **11** and **13** and the concentration of the dilution series used were 50 µM, 10 µM, 5 µM, 1 µM, 0.5 µM and 0.1 µM.

From the fluorescence intensity measured, the proportion of living cells was calculated taking the control (no compound added) as a reference. This proportion, plotted against concentration is shown in Figure S19.

The solvent used for the stock solutions was 50% water-dmso. Due to the poor solubility of some of the compounds in water, in some cases a precipitate was observed in the cell medium. Those points are marked in red in Figure S19.

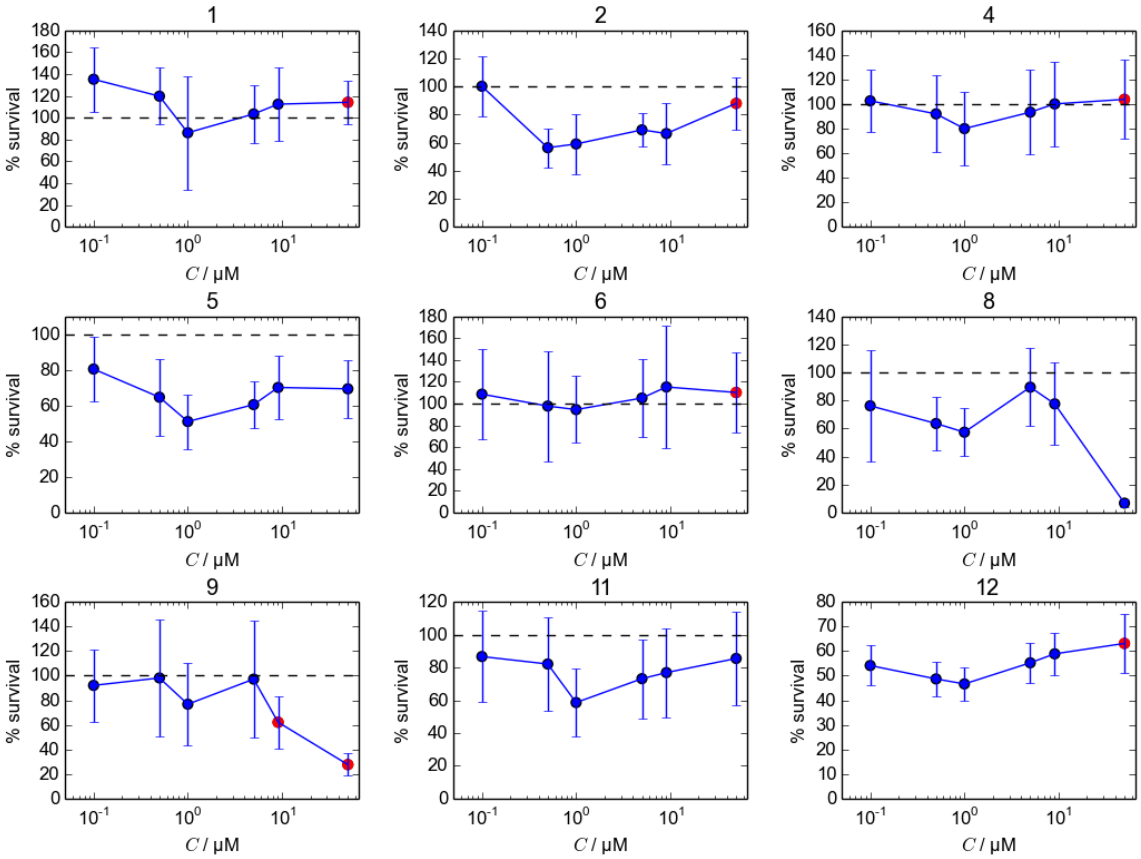


Figure S19: Toxicity of compounds **1**, **2**, **4**, **5**, **6**, **8**, **9**, **11** and **13** in HeLa cells obtained from the Alamar blue viability assay.

References:

1) S. K. Chandran, R. Thakuria and A. Nangia, *CrystEngComm*, 2008, **10**, 1891-1898.
2) A. Bondi, H. E. Spaulding, E. D. Smith and C. C. Dietz., *Am. J. Med. Sci.,* 1947, **213**, 221-225.
3) S. E. Luria., *Bacteriol Rev.,* 1947, 1-40.