Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information

Improved drug delivery and competitive adsorption of paclitaxel and mitomycin C anticancer drugs on the Boron-nitride nanoparticles: a molecular dynamics insight

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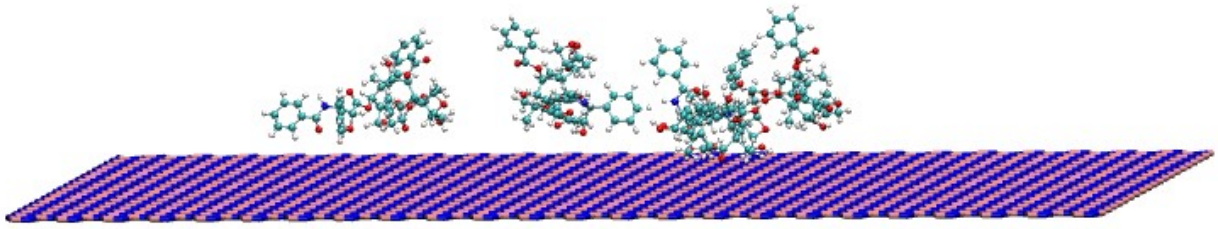
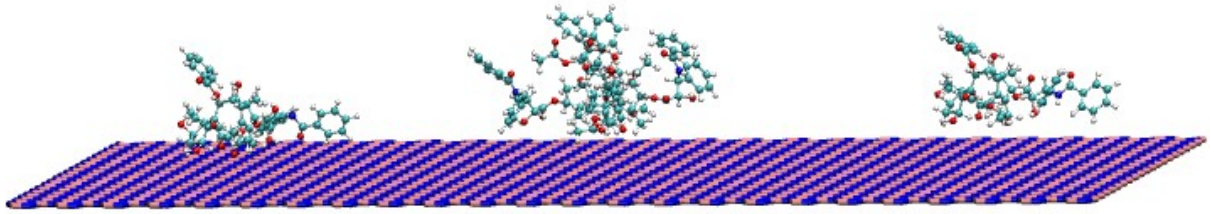
Table S1. Water molecules density profile of two studied systems.

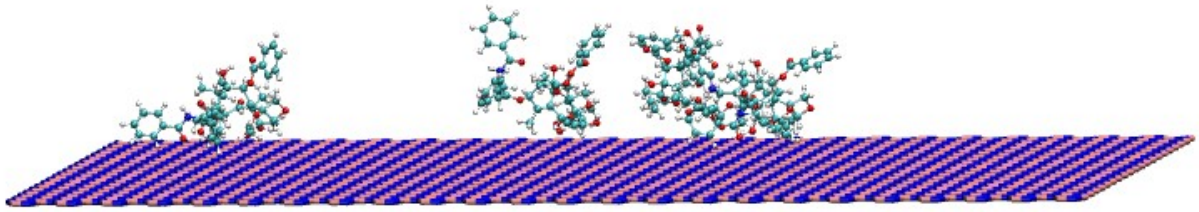
Distance	System containing PX on BNNS	System containing PX and MMC on BNNS
-9.5	0.15	
-8.5	0.78	
-7.5	1.35	
-6.5	0.99	
-5.5	0.56	
-4.5	2.48	
-3.5	0.43	
-2.5	0.27	
-1.5	0.28	
-0.5	0.25	
0.5	0.26	
1.5	0.27	
2.5	0.31	0.00
3.5	0.48	0.09
4.5	2.24	2.51
5.5	0.48	0.47
6.5	1.01	0.62
7.5	1.12	1.48
8.5	0.86	0.72
9.5	0.98	1.01
10.5	0.98	0.98
11.5	1.00	1.03
12.5	0.92	1.01
13.5	1.03	0.99
14.5	0.92	1.01
15.5	1.06	1.11
16.5	1.03	0.92
17.5	0.94	0.97
18.5	0.98	1.03
19.5	1.05	0.99
20.5	0.92	1.08
21.5	1.06	0.99
22.5	0.89	0.80
23.5	1.03	1.41
24.5	0.94	0.81
25.5	1.01	0.52
26.5	1.09	2.67
27.5	0.61	0.09
28.5	0.01	0.00



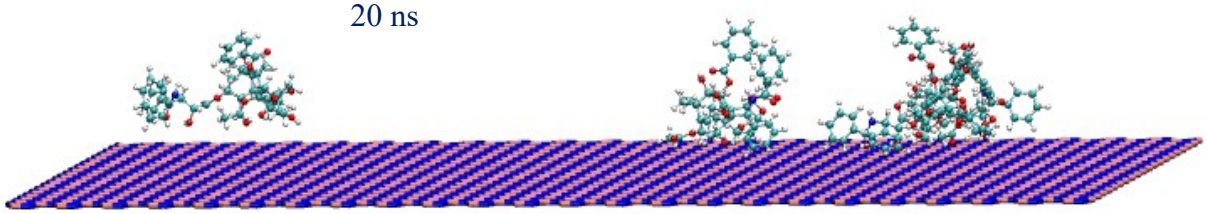
Initial frame of NPT simulation



10 ns



20 ns



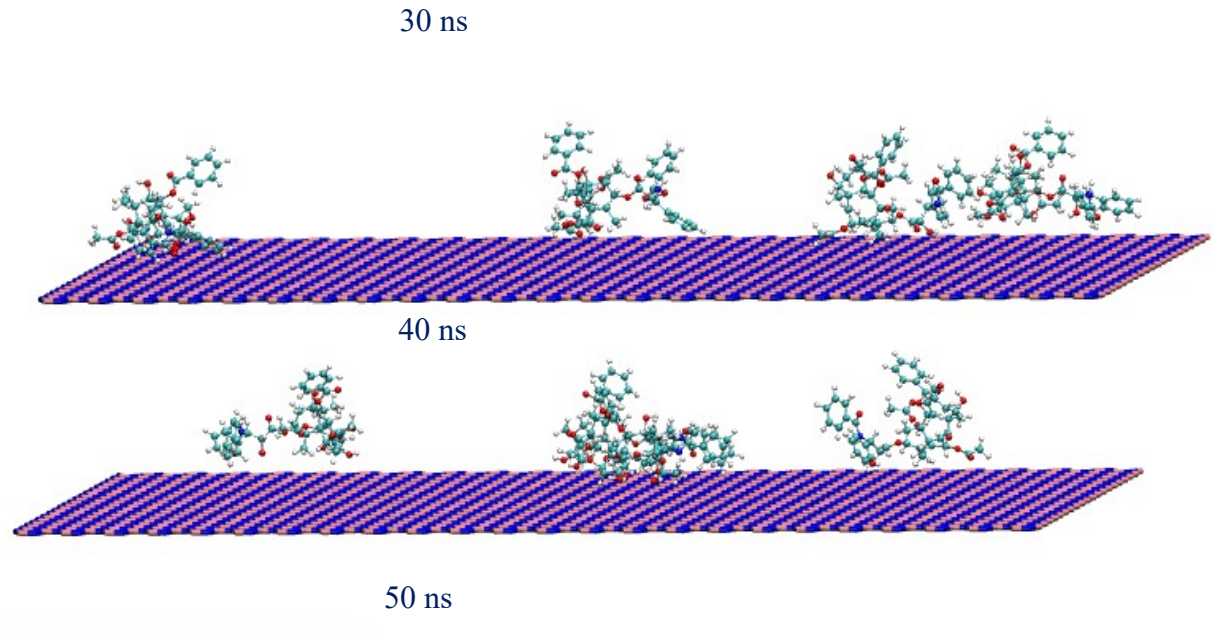
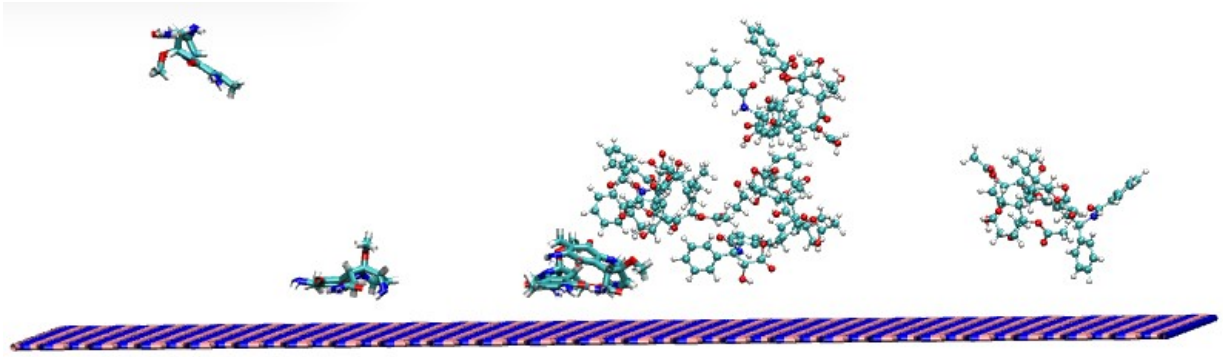
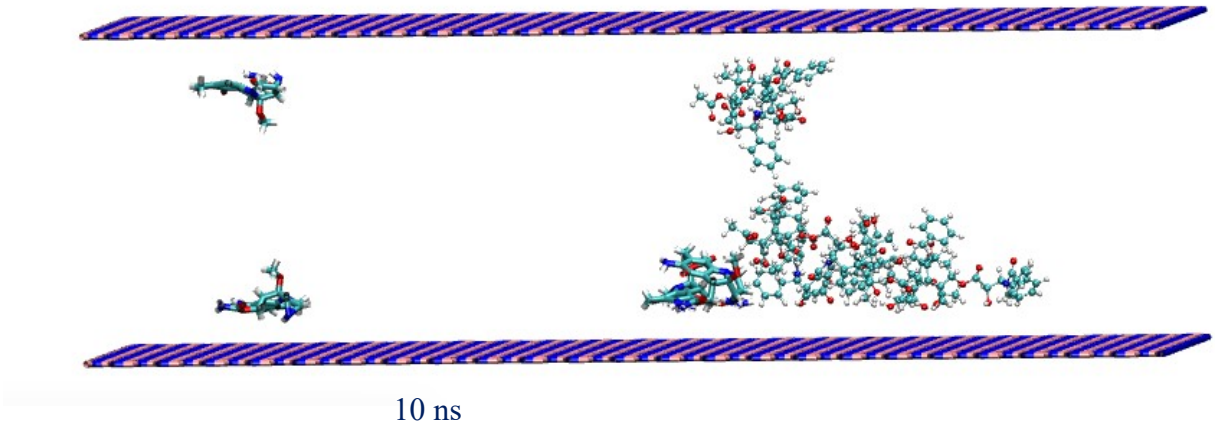


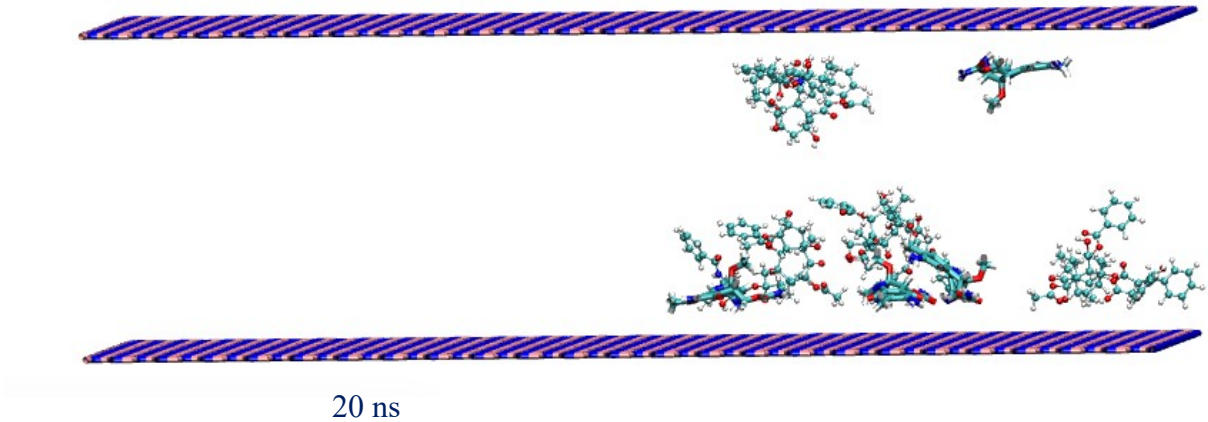
Figure S1. The snapshots of the aggregated and immobilized PX ligands on the BNNS surface along the 50 ns simulation trajectories with 10 ns intervals. In this Figure the water molecules had been eliminated for better visualization of drugs aggregation onto the BNNS surface.



Initial frame of NPT simulation

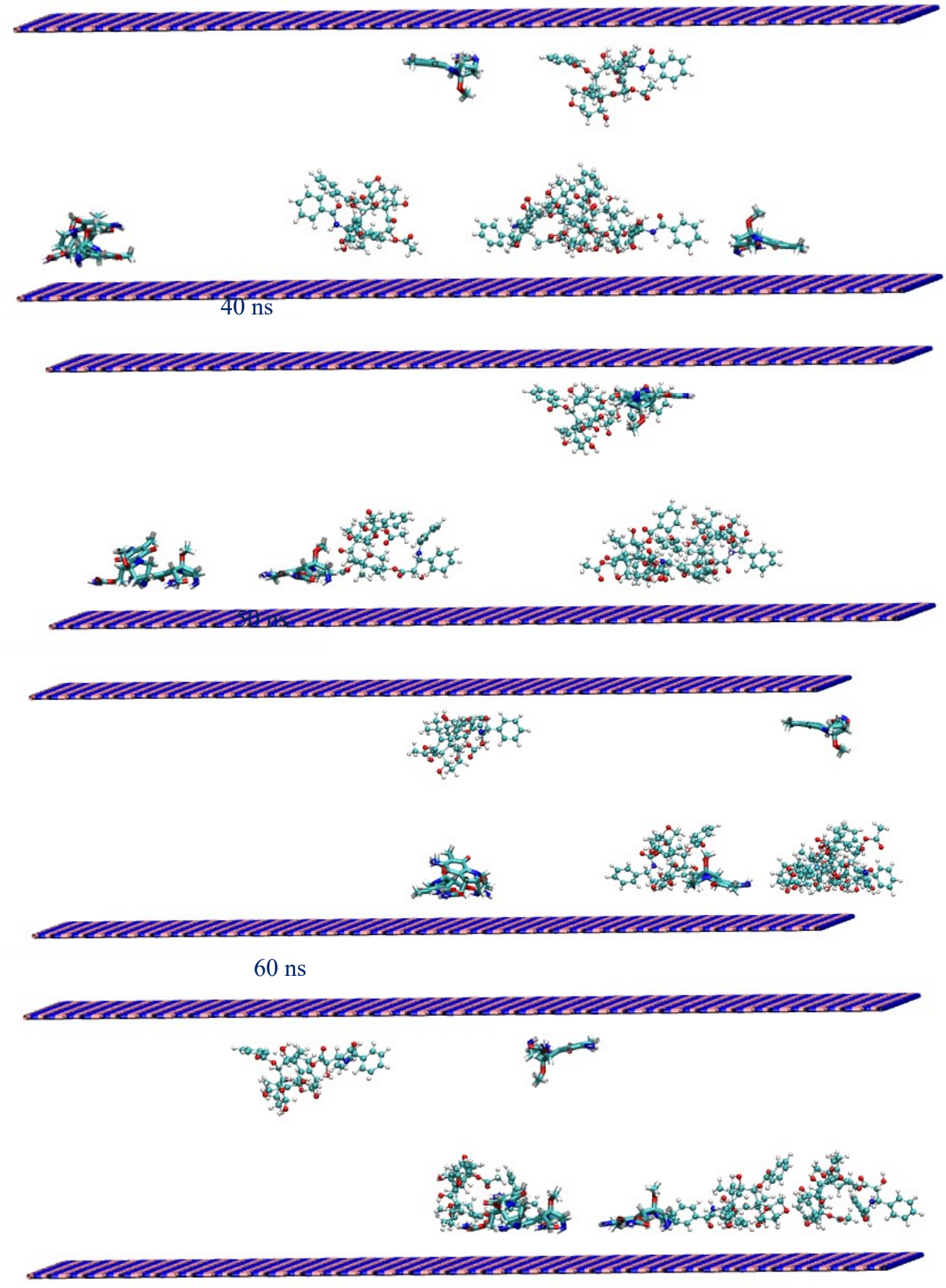


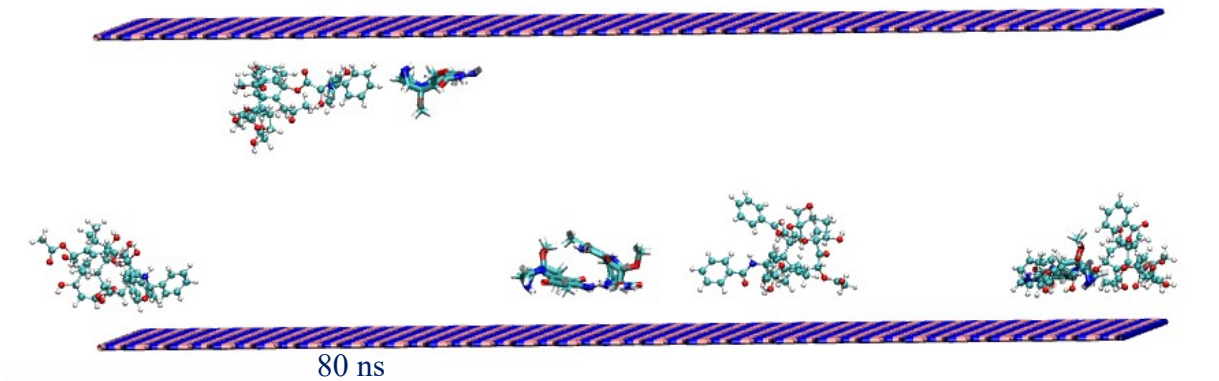
10 ns



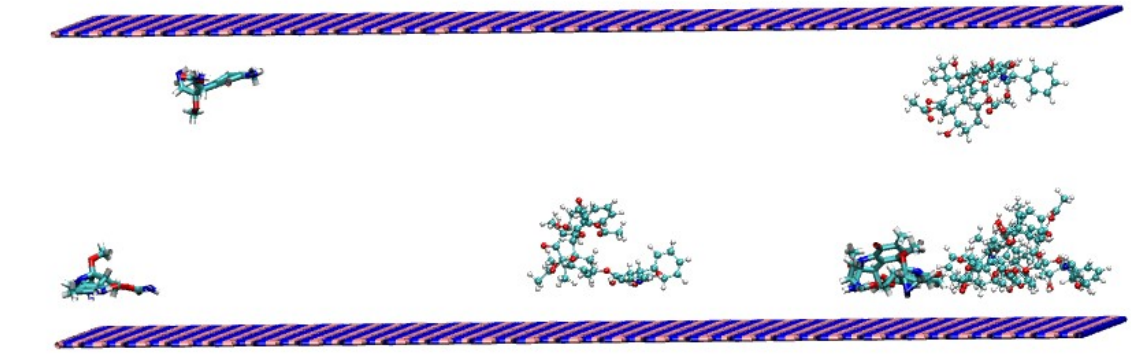
20 ns

30 ns

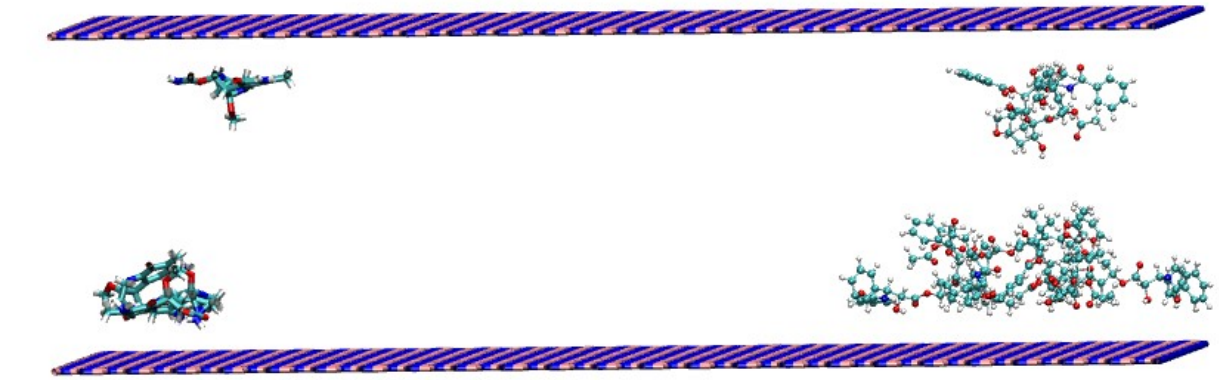

40 ns
60 ns



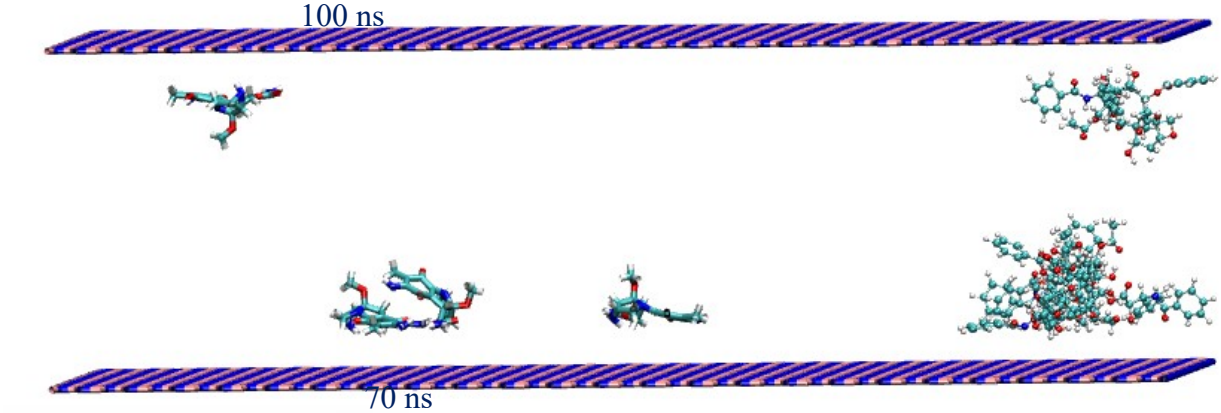
80 ns



90 ns

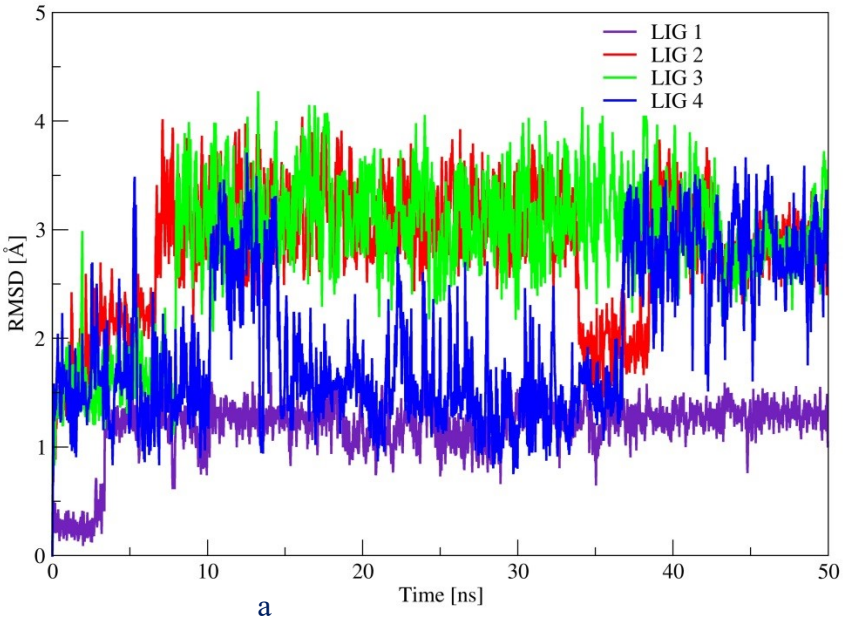


100 ns

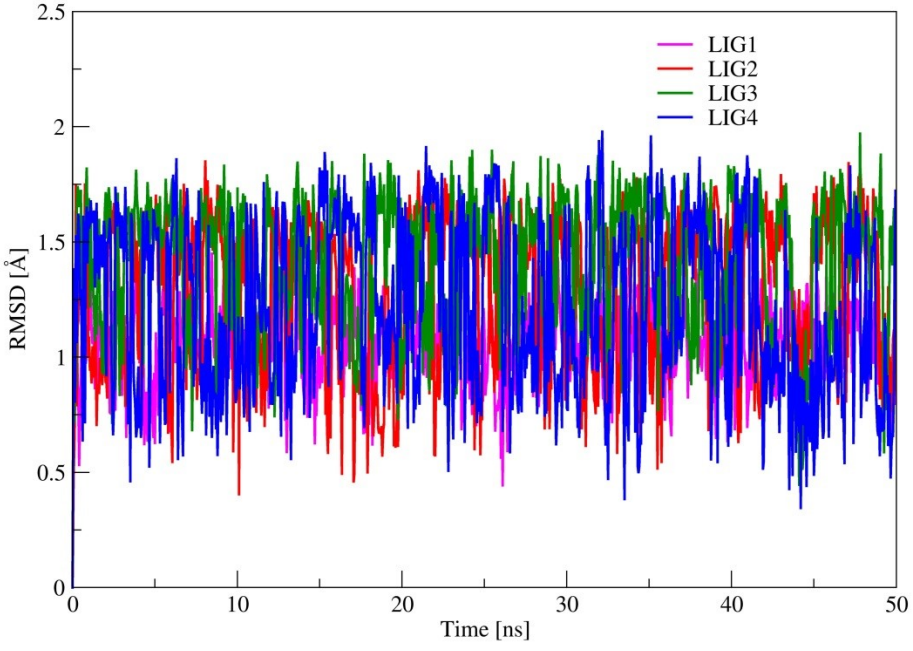


70 ns

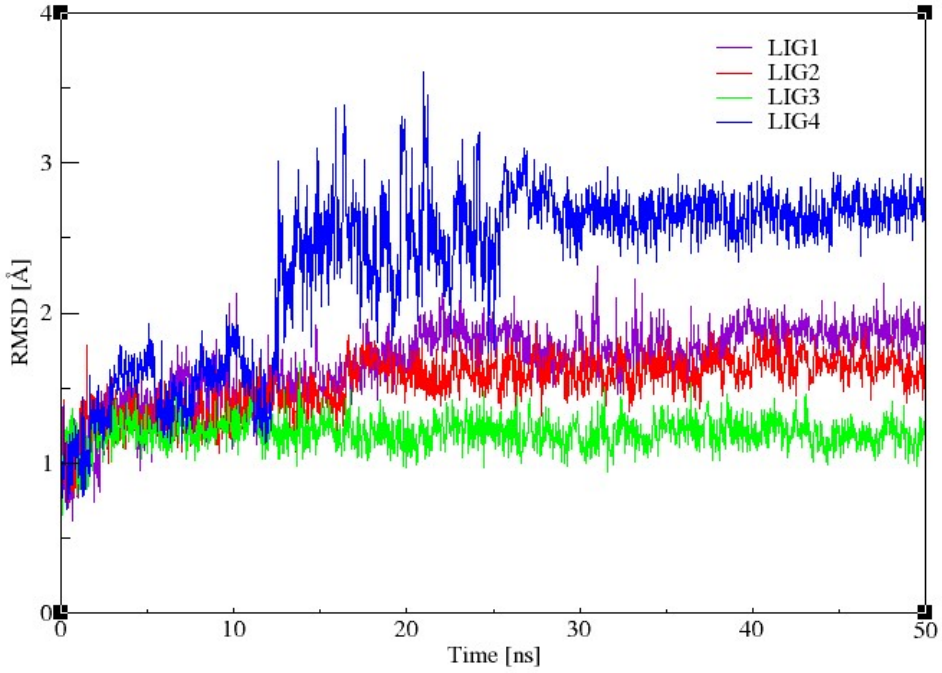
Figure S2. The snapshots of the aggregated and immobilized PX and MMC ligands on the BNNS surface along the100 ns simulation trajectories with 10 ns intervals, the upper sheet presented here is the periodic image of BNNS to indicate the adsorption of all ligands. This Figure is considering the effect of MMC ligands on PX aggregation in comparison to Figure S1. In this Figure the water molecules had been eliminated for better visualization of drugs aggregation onto the BNNS surface.


LIG 1
LIG 2
LIG 3
LIG 4
RMSD [Å]
Time [ns]
0
1
2
3
4
5
0
10
20
30
40
50

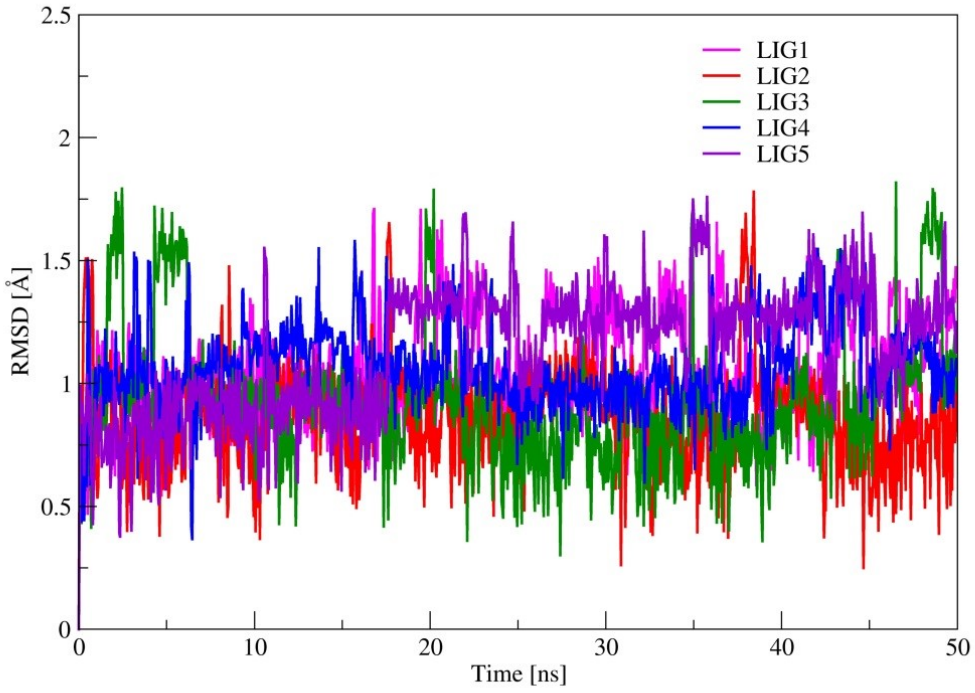
a


LIG1
LIG2
LIG3
LIG4
RMSD [Å]
Time [ns]
0
0.5
1
1.5
2
2.5
0
10
20
30
40
50

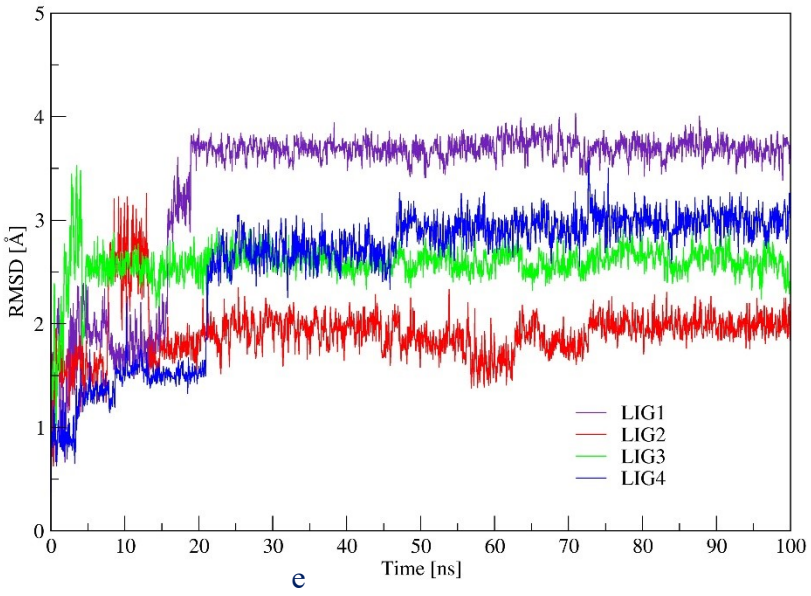
b


LIG1
LIG2
LIG3
LIG4
RMSD [Å]
Time [ns]
0
1
2
3
4
0
10
20
30
40
50

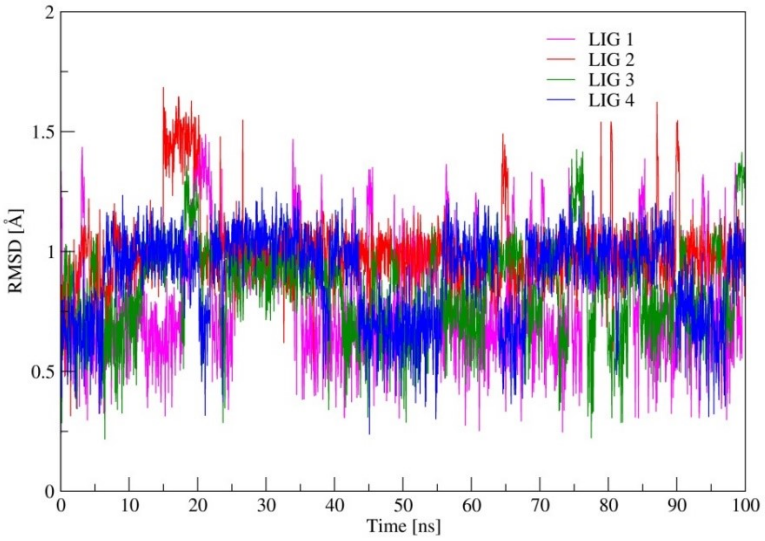
c


LIG1
LIG2
LIG3
LIG4
LIG5
RMSD [Å]
Time [ns]
0
0.5
1
1.5
2
2.5
0
10
20
30
40
50

d

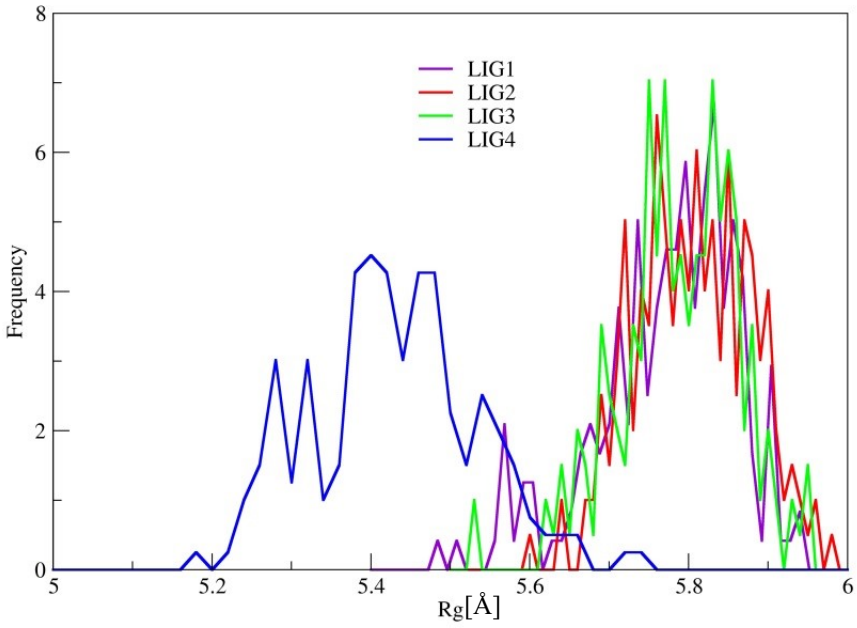


e

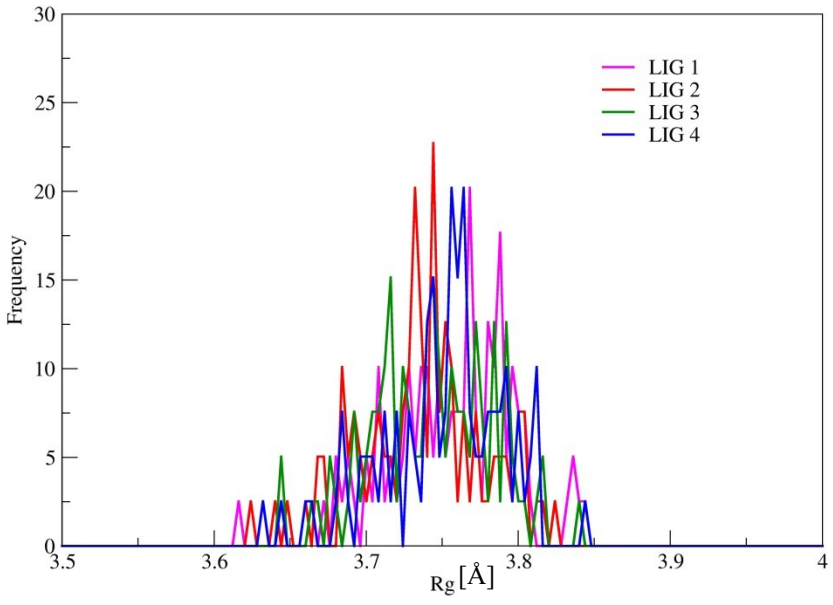


f

Figure S3. (a) Root mean square deviation (RMSD) of 4 non-adsorbed PX in water , (b) non-adsorbed MMC in water, (c) RMSD of 4 PX adsorbed on the BNNS surface after 50 ns simulation time, (d) RMSD of 5 MMC adsorbed on the BNNT surface after 50 ns simulation time, (e) RMSD of 4 PX adsorbed on the BNNS surface during 100 ns simulation time in the system containing PX and MMC on BNNS, and (f) RMSD of 4 MMC adsorbed on the BNNS surface during 100 ns simulation time in the system containing PX and MMC on BNNS.



a



b

Figure S4. Distribution of radius of gyration of (a) non-adsorbed PXs in water (b) non-adsorbed MMCs in water.

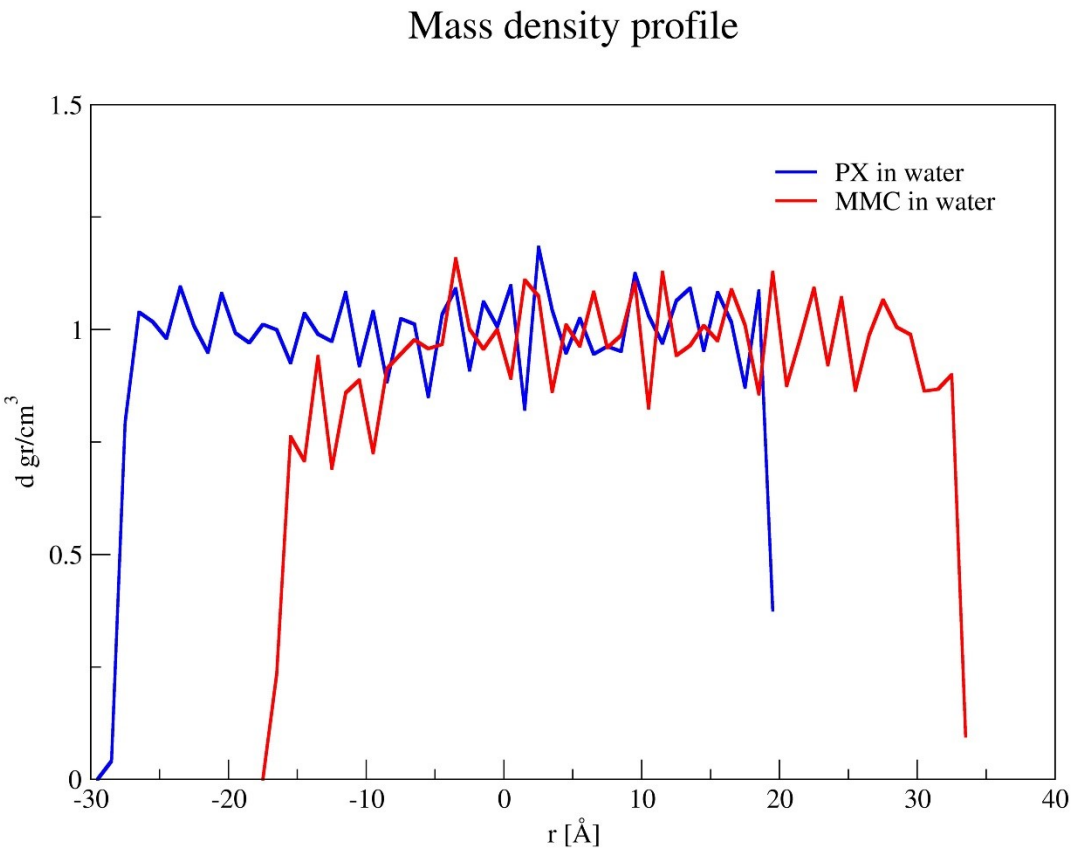
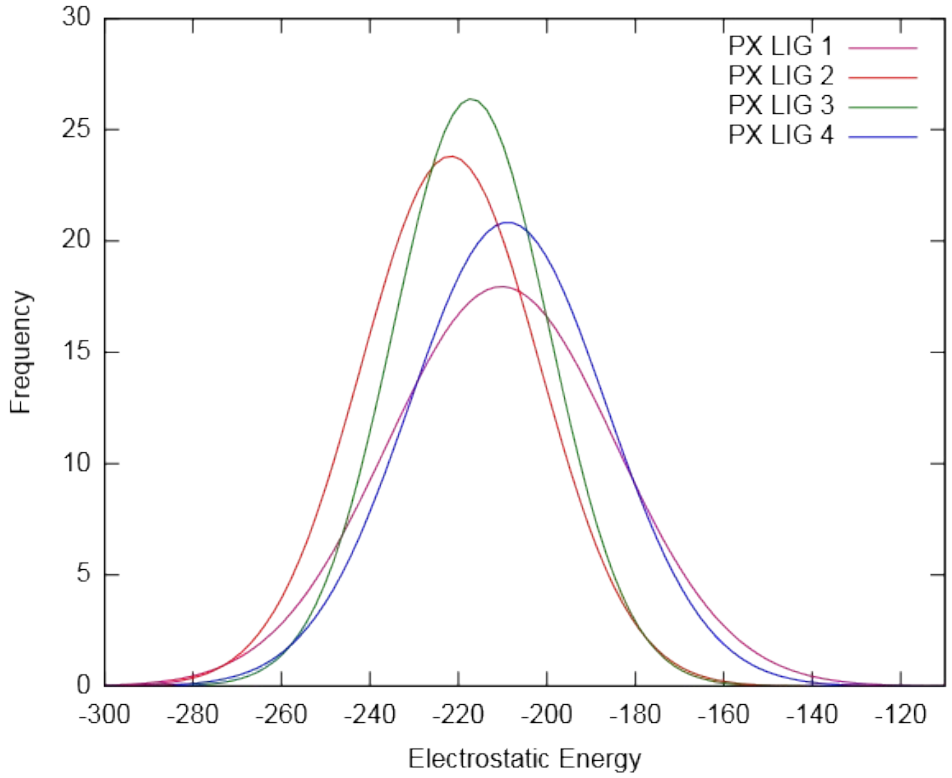
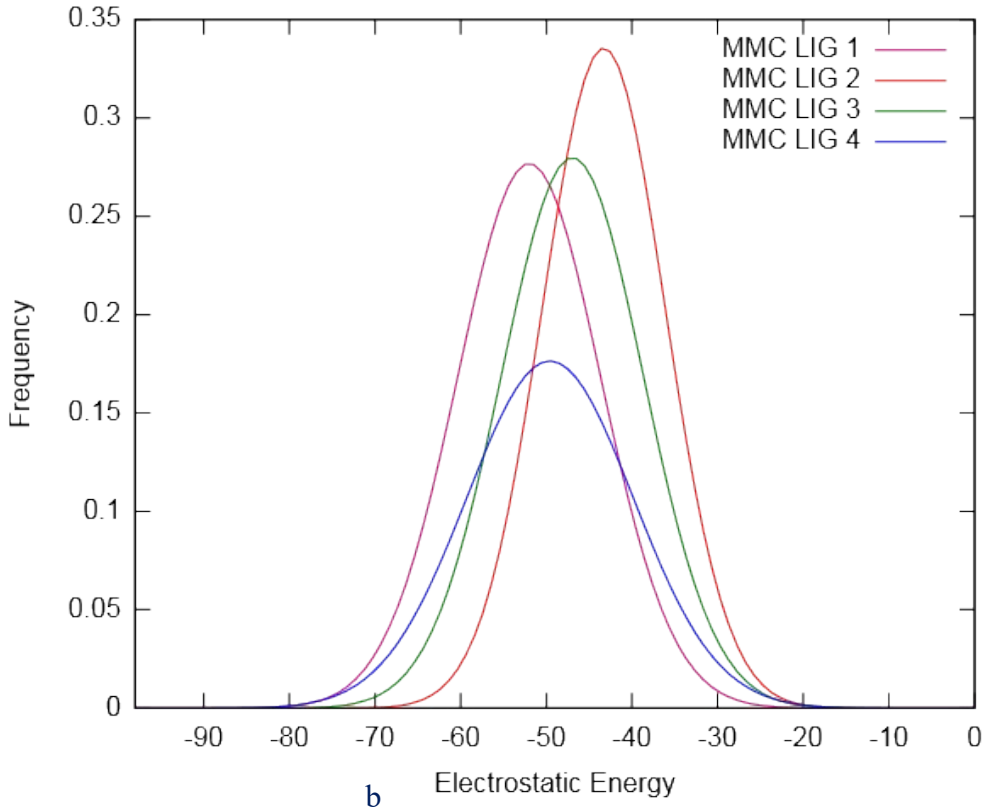


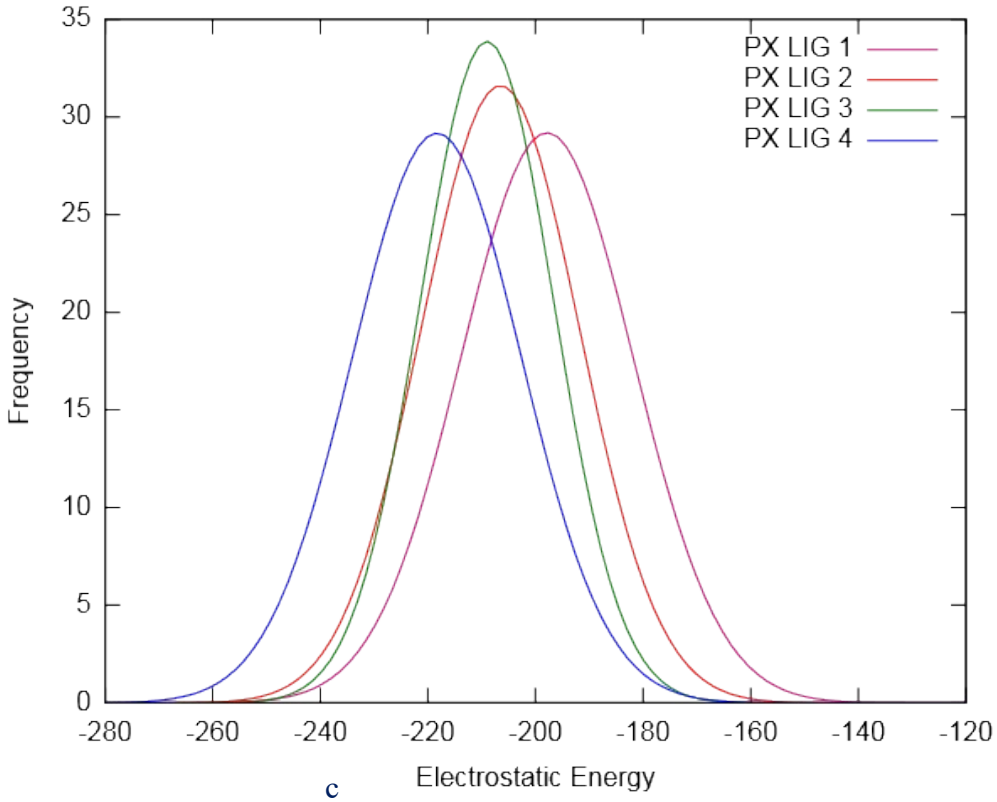
Figure S5. Comparison of the density profile distribution of water molecules of two systems of drug molecules in water solely.


PX LIG 1
PX LIG 2
PX LIG 3
PX LIG 4
Frequency
Electrostatic Energy
30
25
20
15
10
5
0
-300
-280
-260
-240
-220
-200
-180
-160
-140
-120

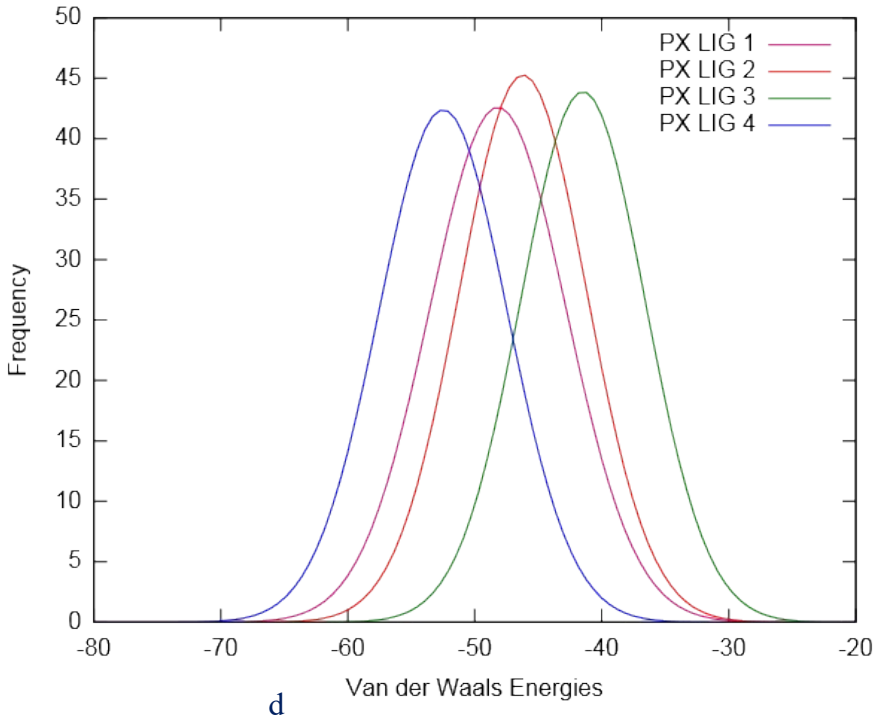
a


MMC LIG 1
MMC LIG 2
MMC LIG 3
MMC LIG 4
Frequency
Electrostatic Energy
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-90
-80
-70
-60
-50
-40
-30
-20
-10
0

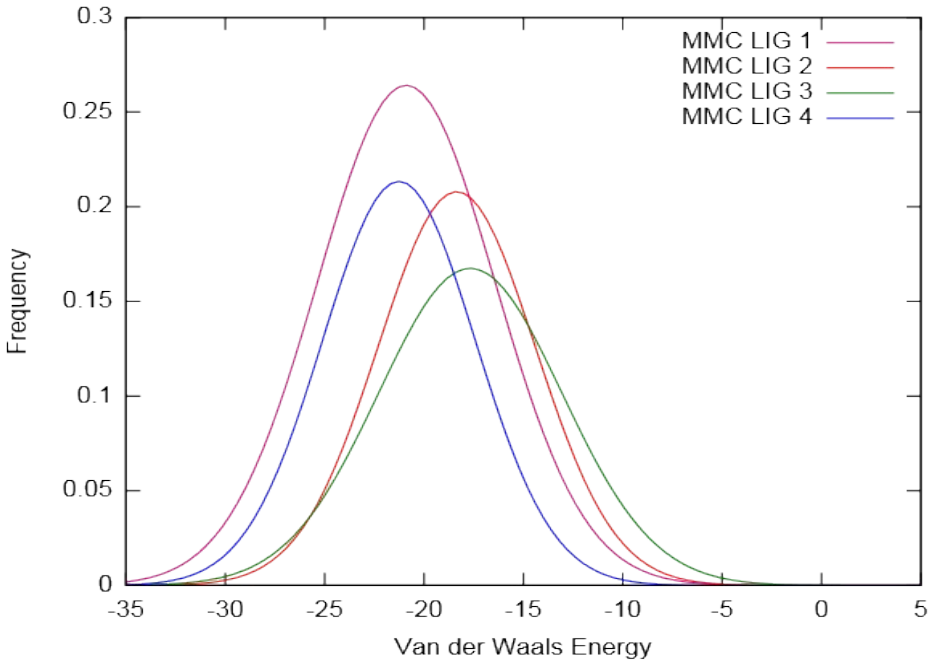
b


PX LIG 1
PX LIG 2
PX LIG 3
PX LIG 4
Frequency
Electrostatic Energy
35
30
25
20
15
10
5
0
-280
-260
-240
-220
-200
-180
-160
-140
-120

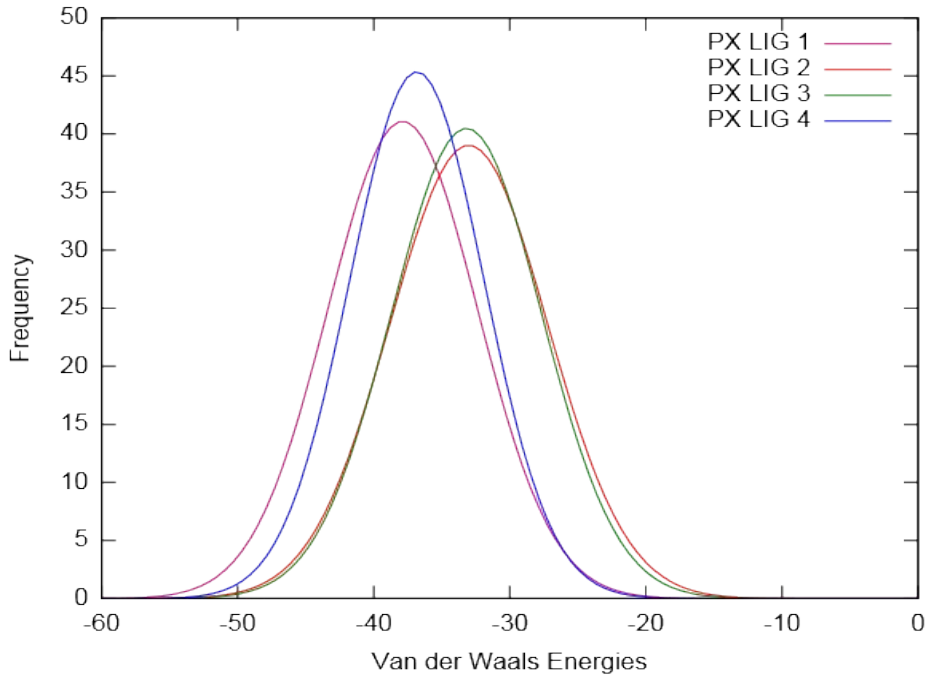
c


PX LIG 1
PX LIG 2
PX LIG 3
PX LIG 4
Frequency
Van der Waals Energies
50
45
40
35
30
25
20
15
10
5
0
-80
-70
-60
-50
-40
-30
-20

d

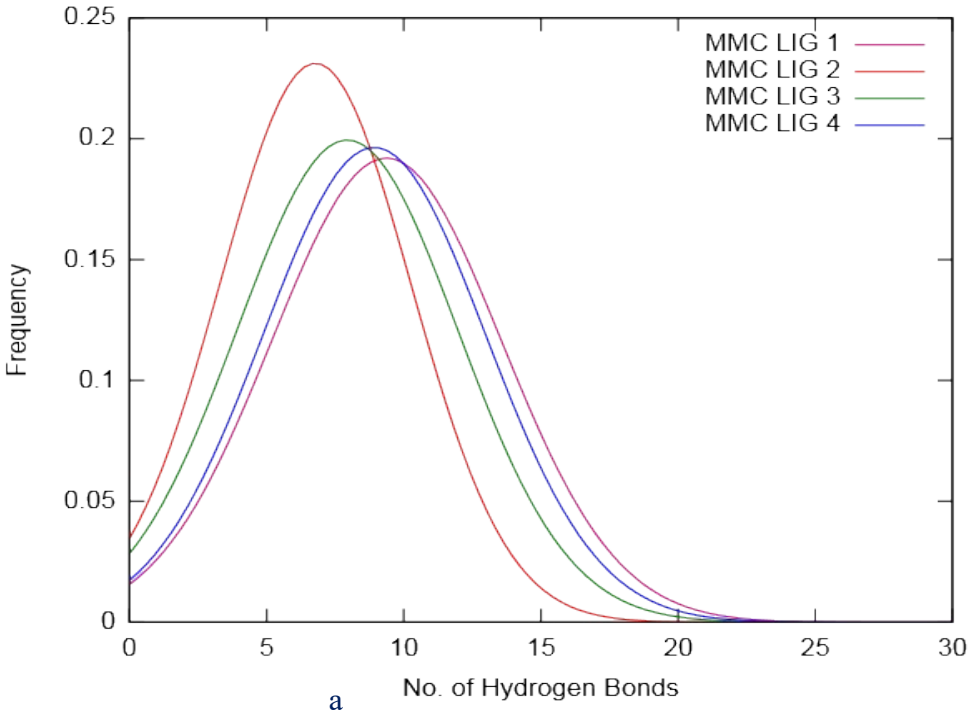


e

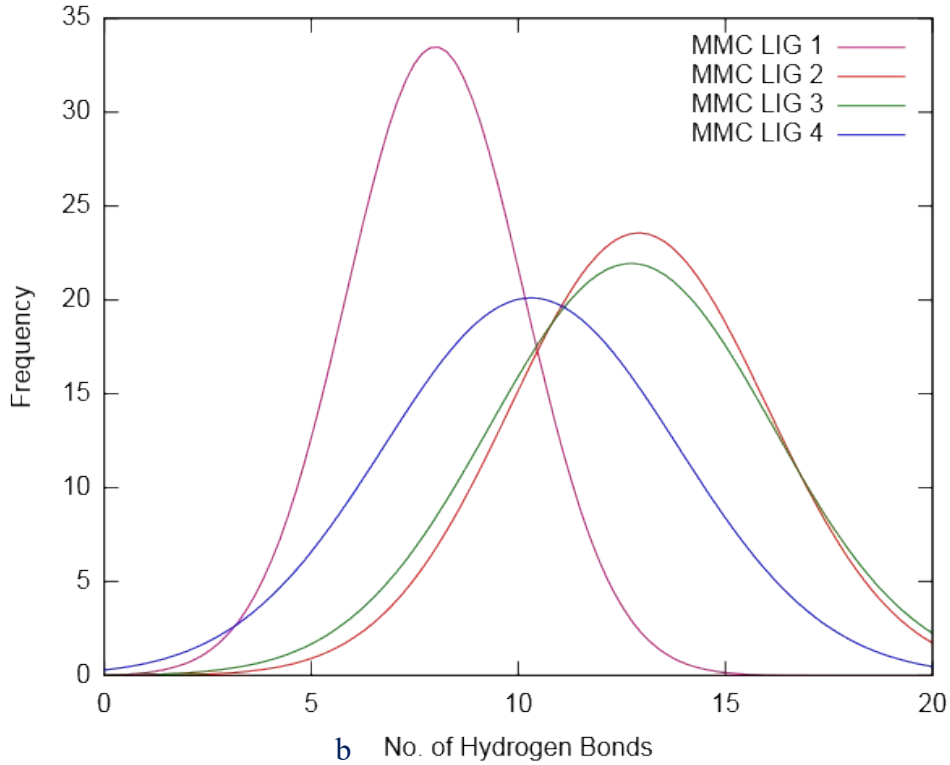


f

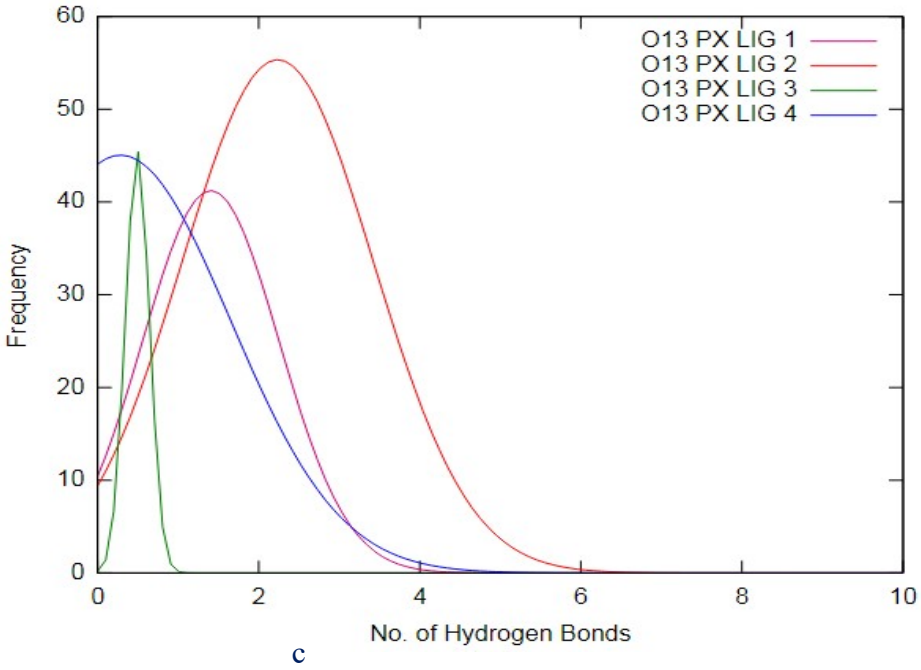
Figure S6. Normalized distribution of electrostatic contributions of (a) non-adsorbed PXs in water system (b) non-adsorbed MMCs in water system (c) PX ligands adsorbed on the BNNS surface, and normalized distribution of van der Waals energies of (d) non-adsorbed PXs in water system (e) non-adsorbed MMCs in water system (f) PX ligands adsorbed on the BNNS surface


MMC LIG 1
MMC LIG 2
MMC LIG 3
MMC LIG 4
Frequency
No. of Hydrogen Bonds
0.25
0.2
0.15
0.1
0.05
0
0
5
10
15
20
25
30

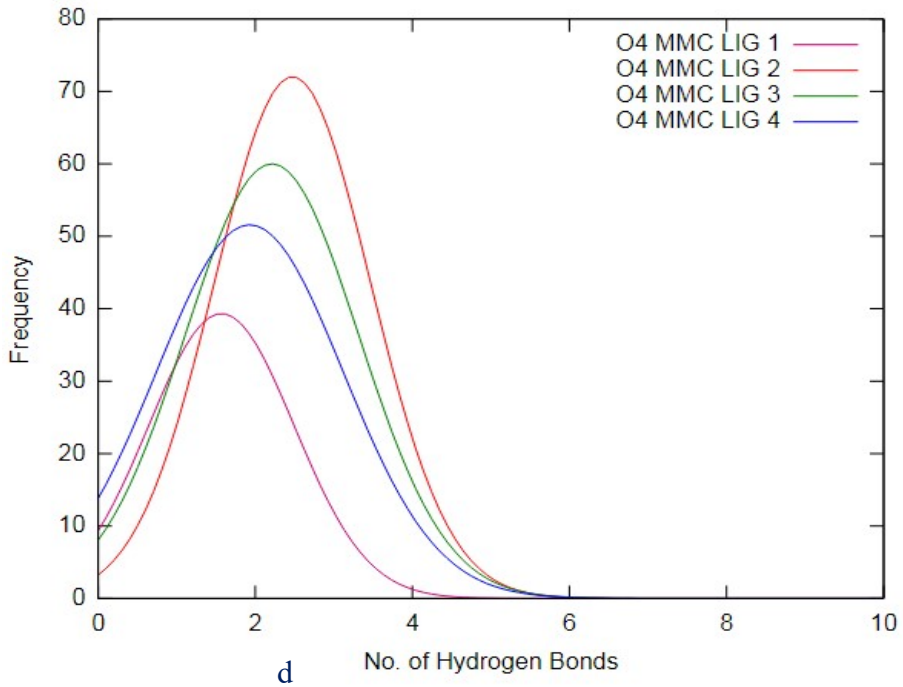
a


MMC LIG 1
MMC LIG 2
MMC LIG 3
MMC LIG 4
Frequency
No. of Hydrogen Bonds
35
30
25
20
15
10
5
0
0
5
10
15
20

b

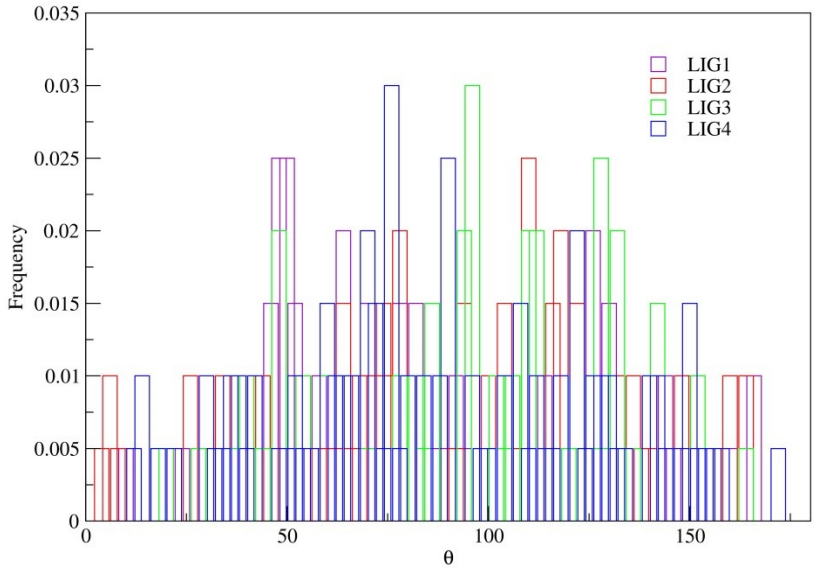


c

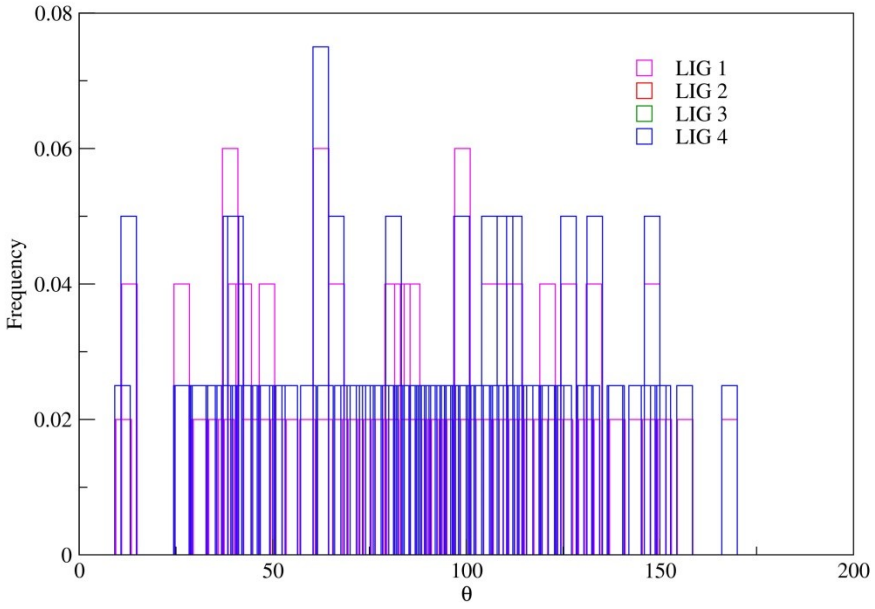


d

Figure S7. Distribution of normalized number of hydrogen bonds of (a) non-adsorbed MMCs in water system (b) MMC ligands adsorbed on the BNNS surface along the 100 ns simulation time in the system contains PX and MMC on BNNS (c) oxygen atoms of MMC (d) oxygen atom of PX ligands in the system contains PX and MMC on BNNS.


LIG1
LIG2
LIG3
LIG4
Frequency
θ
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
50
100
150

a


LIG 1
LIG 2
LIG 3
LIG 4
Frequency
θ
0.08
0.06
0.04
0.02
0
0
50
100
150
200

b

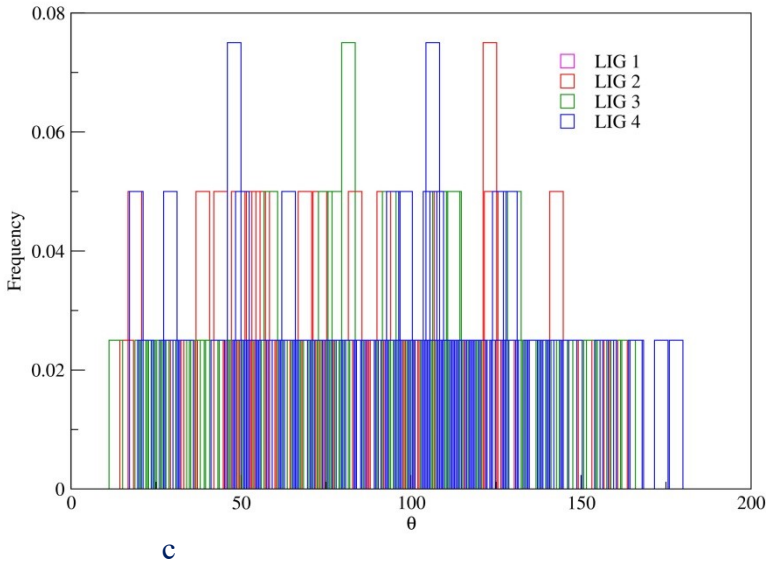
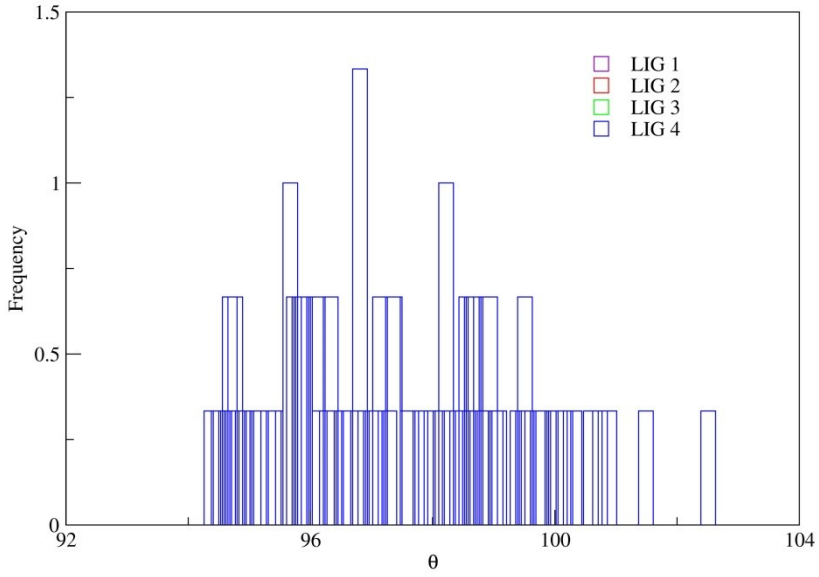
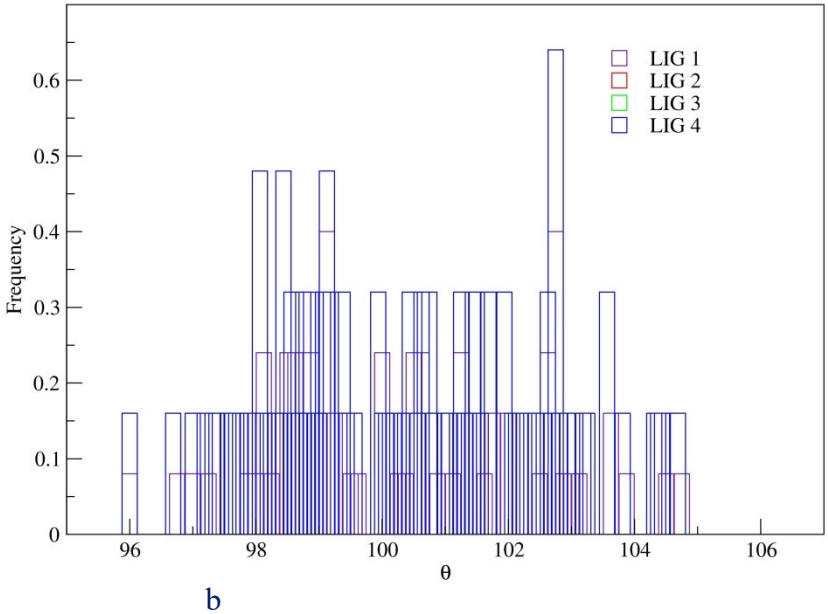


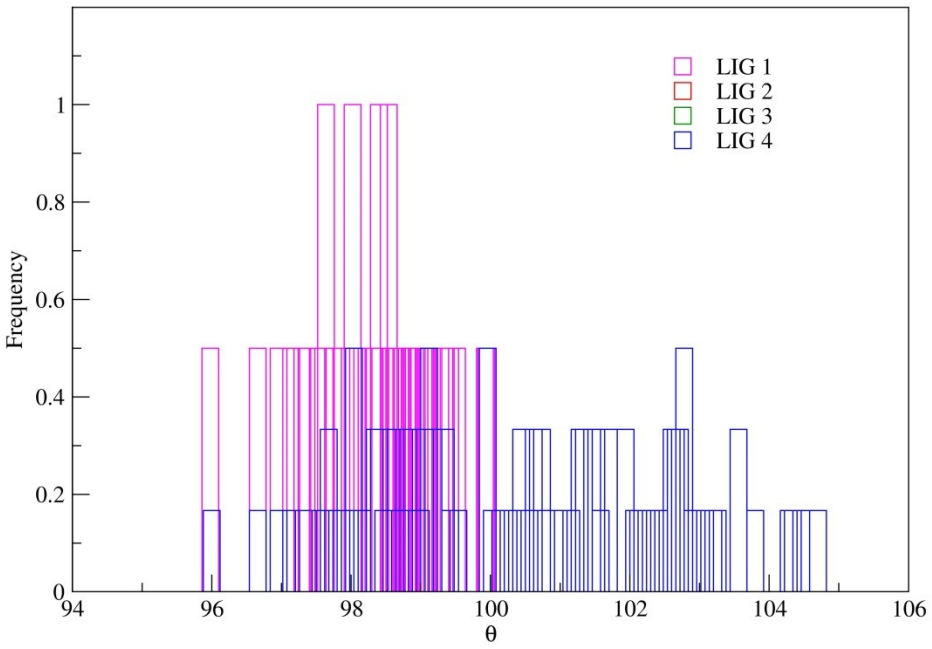
Figure S8. Distribution of angle of water molecules dipole moment vector for (a) non-adsorbed PXs in water system (b) non-adsorbed MMCs in water system (c) MMC ligands adsorbed on the BNNS surface along the 100 ns simulation time in the system contains PX and MMC on BNNS.


LIG 1
LIG 2
LIG 3
LIG 4
Frequency
θ
0
0.5
1
1.5
92
96
100
104

a


LIG 1
LIG 2
LIG 3
LIG 4
Frequency
θ
0
0.1
0.2
0.3
0.4
0.5
0.6
96
98
100
102
104
106

b



c

Figure S9. Distribution of angle of PX and MMC ligands dipole moment vector for (a) PX ligands adsorbed on the BNNS surface (b) PX ligands adsorbed on the BNNS surface along the 100 ns simulation time in the system contains PX and MMC on BNNS, (c) MMC ligands adsorbed on the BNNS surface along the 100 ns simulation time in the system contains PX and MMC on BNNS.