

Supporting Information

**Haeckelite Phosphorous: An Emerging 2D Allotrope of Phosphorous for  
Potential Use in LIBs/SIBs**

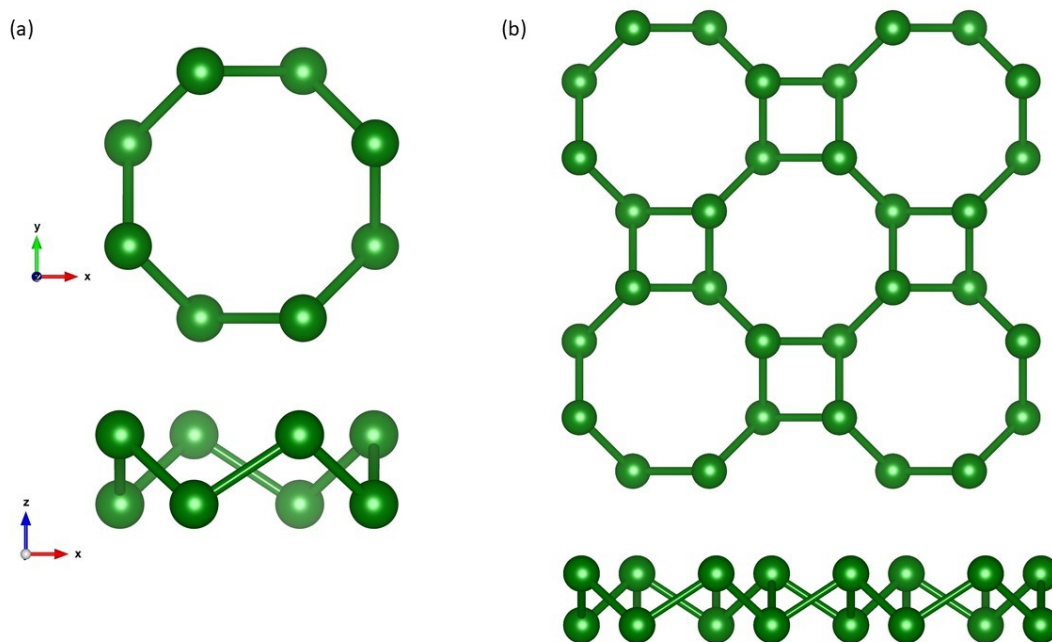
Gayatree Barik<sup>1</sup> and Sourav Pal<sup>1,2\*</sup>

<sup>1</sup>Department of Chemistry, Indian Institute of Technology Bombay, Mumbai-400 076, India

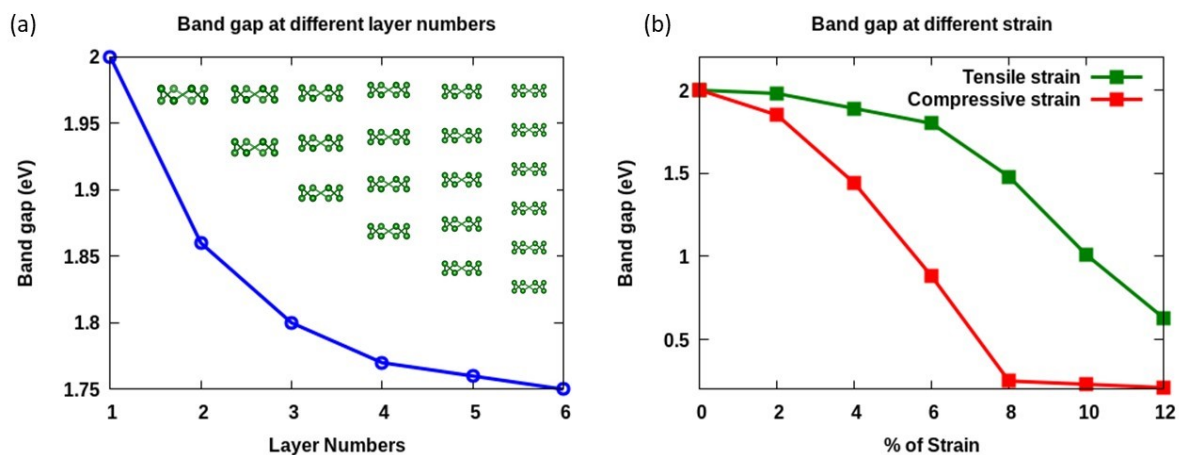
<sup>2</sup>Department of Chemical Sciences, Indian Institute of Science Education and Research  
Kolkata, Mohanpur-741 246, India

Email: [s.pal@iiserkol.ac.in](mailto:s.pal@iiserkol.ac.in)

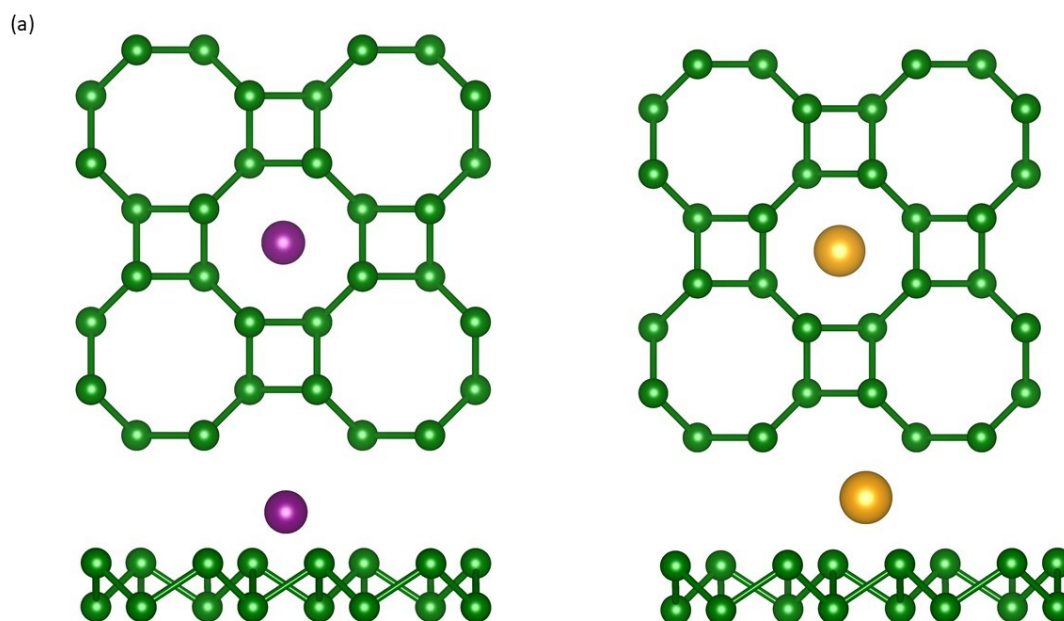
**Fig. S1:** Top and side view of the (a) octagonal unit cell of HaeckP and (b) Optimized geometry of a  $2 \times 2$  supercell of Haeck-P.

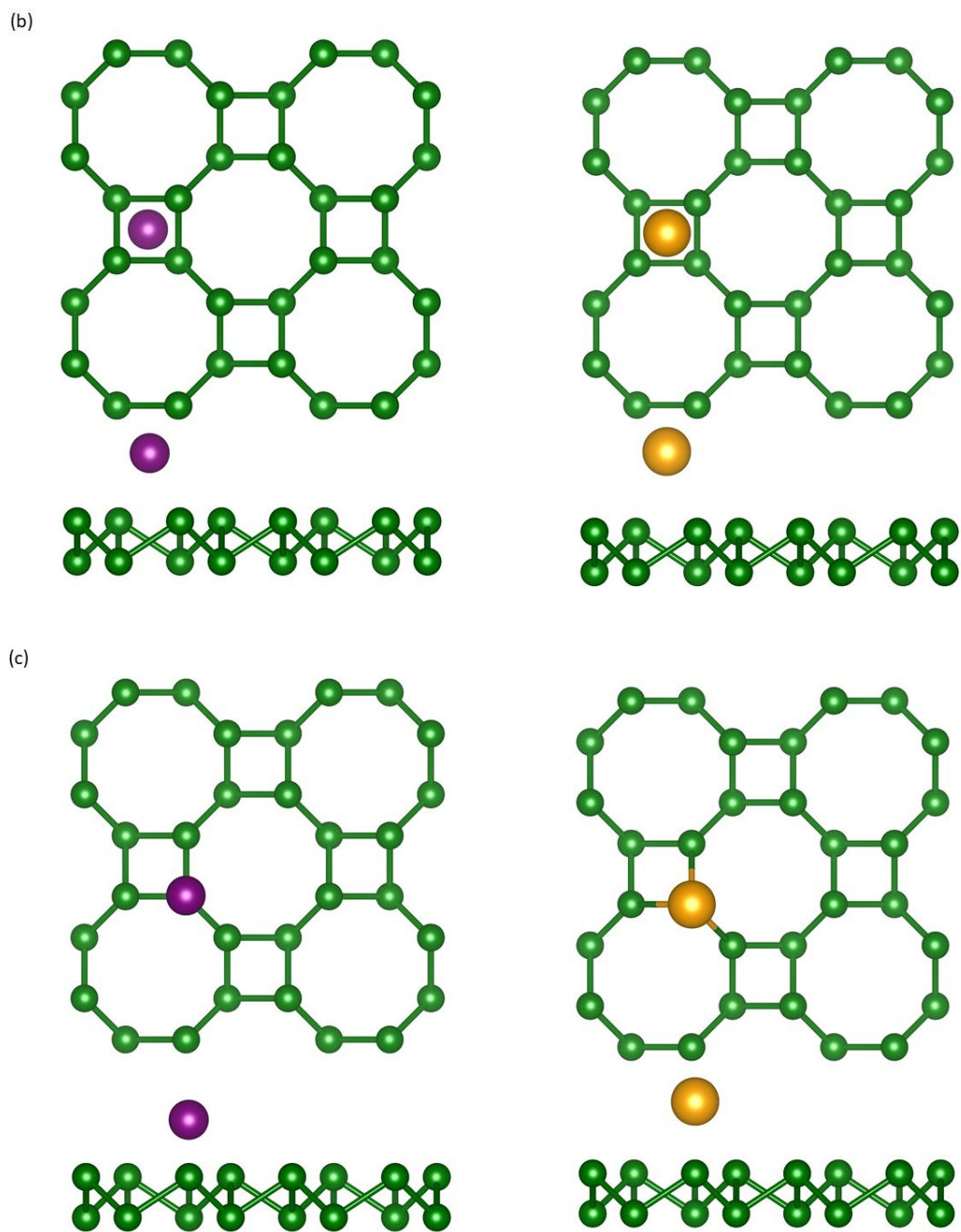


**Fig. S2:** (a) The relationship between the bandgap values and the number of Haeck phosphorene layers. (b) The strain tunable bandgap properties of Haeck Phosphorous.

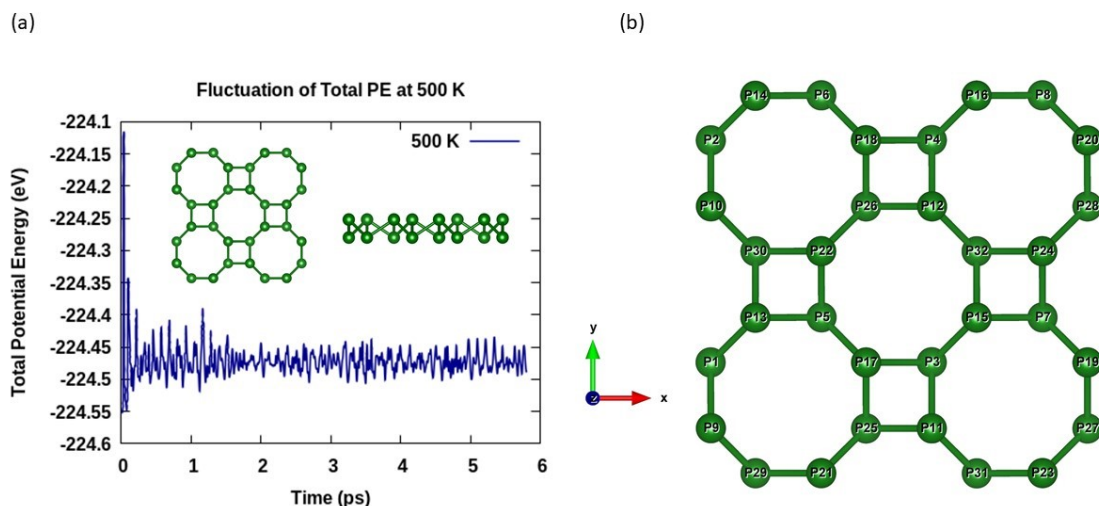


**Fig. S3:** The top and side views of possible Li (left) and Na (right) adsorption sites on the surface of HaeckP. (a) Li/Na adsorption on the top of the octagonal hollow position, (b) on the center of square hollow position, (c) Above the top of phosphorous. The green, purple and yellow balls represent P, Li, and Na atoms, respectively.

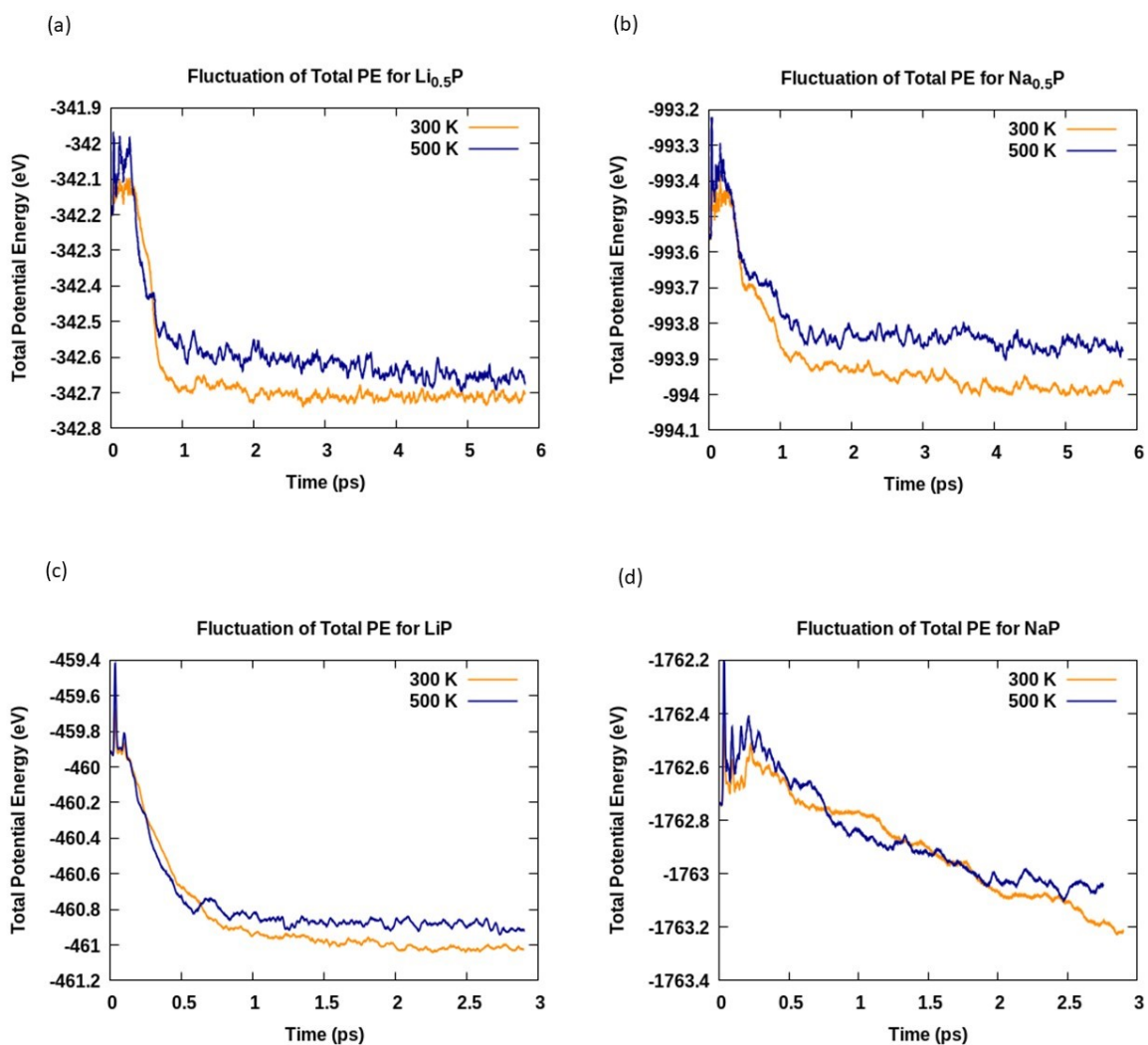




**Fig. S4:** Ab-initio molecular dynamics simulations. (a) 500K, and (b) Structure of Haeck P showing various bonds to distinguish the change in bond lengths and bond angles.



**Fig. S5.** Ab-initio molecular dynamics simulations at 300K and 500K under different stoichiometry. (a)  $\text{Li}_{0.5}\text{P}$  (b)  $\text{Na}_{0.5}\text{P}$  (c)  $\text{LiP}$  (d)  $\text{NaP}$



**Table S1:** Calculated Bandgap and thickness of few layers HeackP.

Number of Layers	Bandgap (eV)	Thickness (Å)
1	2.00	1.24
2	1.86	7.24
3	1.80	13.24
4	1.77	19.24
5	1.76	25.24
6	1.75	31.24

**Table S2:** Calculated structural and electronic properties of HeackP by the application of strain.

% Of strain	Lattice constant (Å)	Thickness (Å)	Bandgap in eV (PBE)	Bandgap in eV (HSE06)
-12	5.68	1.357	0.20	-
-10	5.81	1.336	0.23	-
-8	5.94	1.316	0.25	1.48
-6	6.07	1.296	0.88	2.10
-4	6.20	1.278	1.44	2.63
-2	6.33	1.260	1.95	2.90
0	6.46	1.245	2.00	2.96
2	6.59	1.231	1.98	2.70
4	6.72	1.219	1.89	2.69
6	6.84	1.207	1.80	2.59
8	6.97	1.196	1.48	2.47
10	7.10	1.188	1.01	-
12	7.23	1.181	0.63	-

**Table S3:** Calculated single Li/Na adsorption energies at the octagonal hollow position of Haeck P with different vdW corrections.

Procedure	$E_{ad}$ in eV (Li)	$E_{ad}$ in eV (Na)
vdw-DF	-1.77	-1.31

vdw-DF2	-1.83	-1.29
PBE	-1.87	-1.31
PBE+D2	-2.12	-1.61
PBE+D3	-1.94	-1.44
PBE+D3-BJ	-1.86	-1.31
PBE+TS	-2.14	-1.93
PBE+TS+SCS	-1.93	-1.21

**Table S4:** Calculated single Li/Na adsorption energies of multilayer Haeck P at the octagonal hollow position with vdw-DF2 functional.

No of Layers	Adsorption location	$E_{ad}$ in eV (Li)	$E_{ad}$ in eV (Na)
Bilayer	interface	-1.93	-1.43
	surface	-1.66	-1.09
Trilayer	interface	-1.97	-1.49
	surface	-1.65	-1.09

**Table S5:** The change in bond lengths after the end of simulations at 300K.

Bond	Bond Length (Å)	Bond	Bond Length (Å)	Bond	Bond Length (Å)	Bond	Bond Length (Å)
P1-P9	2.288	P30-P10	2.243	P4-P16	2.231	P15-P7	2.306
P9-P29	2.234	P10-P2	2.305	P16-P8	2.297	P15-P3	2.241
P29-P21	2.299	P2-P14	2.232	P8-P20	2.236	P3-P11	2.306
P21-P25	2.241	P14-P16	2.309	P20-P28	2.295	P11-P31	2.253
P25-P17	2.298	P6-P18	2.243	P28-P24	2.244	P31-P23	2.301
P17-P5	2.235	P18-P26	2.306	P24-P32	2.300	P23-P27	2.242
P5-P13	2.308	P26-P22	2.240	P32-P12	2.241	P27-P19	2.307
P13-P30	2.314	P26-P12	2.301	P12-P26	2.301	P19-P7	2.249
P30-P22	2.302	P12-P14	2.308	P32-P15	2.314	-	-
P22-P5	2.304	P4-P18	2.309	P24-P7	2.308	-	-

**Table S6:** The change in bond angles after the end of simulations at 300K.

Bond	Bond Angle (°)	Bond	Bond Angle (°)	Bond	Bond Angle (°)	Bond	Bond Angle (°)
P1-P9-P29	100.665	P27-P19-P7	99.965	P20-P8-P16	100.271	P14-P2-P10	99.680
P9-P29-P21	100.166	P19-P7-P15	99.868	P8-P16-P4	100.570	P2-P10-P30	99.921
P29-P21-P25	100.109	P19-P7-P24	100.141	P16-P4-P12	99.928	P10-P30-P22	99.673
P21-P25-P17	99.982	P7-P15-P3	100.109	P16-P4-P18	100.180	P10-P30-P13	100.061
P21-P25-P11	100.020	P15-P3-P17	100.334	P4-P12-P32	100.240	P30-P13-P1	100.222
P25-P11-P3	72.270	P7-P15-P32	72.132	P12-P32-P24	99.773	P13-P1-P9	100.095
P25-P17-P3	72.270	P15-P32-P24	72.259	P12-P26-P22	100.393	P30-P13-P5	72.229
P17-P3-P11	72.276	P32-P24-P7	72.339	P12-P26-P18	72.56	P13-P5-P22	72.529
P11-P25-P17	72.335	P24-P7-P15	72.265	P12-P4-P18	72.385	P5-P22-P30	72.498
P5-P11-P31	99.936	P7-P24-P28	100.053	P4-P18-P26	72.269	P22-P30-P13	72.469
P11-P31-P23	99.90	P24-P32-P12	99.773	P26-P12-P4	72.357	-	-
P31-P23-P27	100.157	P24-P28-P20	100.119	P18-P6-P14	99.628	-	-
P23-P27-P19	99.710	P28-P20-P8	100.701	P16-P14-P2	100.094	-	-

### Atomic coordinates of various Li/Na Concentrations:

#### 1. $Li_{0.5}P$

48

```

P 0.94984473 4.17852631 9.37322187
P 0.94984473 10.63852386 9.37322187
P 7.40984231 4.17852631 9.37322187
P 7.40984231 10.63852386 9.37322187
P 4.17916977 5.51088125 9.37335941
P 4.17916977 11.97087880 9.37335941
P 10.63916733 5.51088125 9.37335941
P 10.63916733 11.97087880 9.37335941
P 0.94922505 2.28125290 10.61841765
P 0.94922505 8.74125045 10.61841765
P 7.40922259 2.28125290 10.61841765
P 7.40922259 8.74125045 10.61841765
P 2.28175074 5.50987596 10.61839643
P 2.28175074 11.96987351 10.61839643

```

P	8.74174828	5.50987596	10.61839643
P	8.74174828	11.96987351	10.61839643
P	5.51077251	4.17902800	10.61838259
P	5.51077251	10.63902553	10.61838259
P	11.97077006	4.17902800	10.61838259
P	11.97077006	10.63902553	10.61838259
P	4.17811564	0.95011711	10.61832215
P	4.17811564	7.41011466	10.61832215
P	10.63811320	0.95011711	10.61832215
P	10.63811320	7.41011466	10.61832215
P	5.51012721	2.28167223	9.37331331
P	5.51012721	8.74166979	9.37331331
P	11.97012477	2.28167223	9.37331331
P	11.97012477	8.74166979	9.37331331
P	2.28061305	0.94911630	9.37342215
P	2.28061305	7.40911387	9.37342215
P	8.74061061	0.94911630	9.37342215
P	8.74061061	7.40911387	9.37342215
Li	2.13938403	1.08557778	12.41188647
Li	2.13880353	7.53955452	12.41182033
Li	8.61851935	1.08673298	12.41055975
Li	8.61744163	7.54055317	12.40974247
Li	2.14106288	5.38145729	7.58768244
Li	2.14118788	11.83585460	7.58706276
Li	8.61899889	5.38057011	7.58823262
Li	8.62034908	11.83443073	7.58834178
Li	4.30253515	5.37952098	12.40979537
Li	4.30142022	11.83336764	12.41065863
Li	10.78109048	5.38057136	12.41190751
Li	10.78056479	11.83448498	12.41199699
Li	4.29960202	1.08566274	7.58850840
Li	4.30096734	7.53960823	7.58836218
Li	10.77871417	1.08423144	7.58715420
Li	10.77882275	7.53866306	7.58773592

## 2. $Na_{0.5}P$

48

P	0.96422834	4.16748037	9.88609365
P	0.96422133	10.56247992	9.88612412
P	7.35921242	4.16747379	9.88609749
P	7.35921755	10.56248688	9.88612370
P	4.16136978	5.43444955	9.86117432
P	4.16137550	11.82948961	9.86119015
P	10.55637710	5.43444773	9.86118364
P	10.55637713	11.82949220	9.86118591
P	0.96370127	2.22526586	11.11481918
P	0.96370758	8.62021571	11.11478356
P	7.35869809	2.22525922	11.11481515
P	7.35869036	8.62022237	11.11477855
P	2.23481782	5.43271086	11.13531413
P	2.23481525	11.82775071	11.13531110
P	8.62981382	5.43271041	11.13530568
P	8.62981470	11.82775609	11.13531522
P	5.43117089	4.16967136	11.11151124
P	5.43117676	10.56467574	11.11148885
P	11.82618647	4.16966435	11.11151370



P	11.82618053	10.56467998	11.11149186
P	4.15981594	0.96231686	11.13520757
P	4.15981433	7.35725003	11.13520073
P	10.55481769	0.96231494	11.13521265
P	10.55482030	7.35725138	11.13519472
P	5.43039767	2.22752741	9.88589589
P	5.43039284	8.62247705	9.88591714
P	11.82540034	2.22752265	9.88589369
P	11.82540752	8.62248308	9.88591901
P	2.23382644	0.96058560	9.86466687
P	2.23382690	7.35551406	9.86465912
P	8.62882622	0.96058078	9.86466051
P	8.62882291	7.35551590	9.86466634
Na	4.46112683	5.17710445	13.75424553
Na	4.46109510	11.57197524	13.75416103
Na	10.85604747	5.17713601	13.75425265
Na	10.85608663	11.57194338	13.75418501
Na	1.93389091	1.21728125	13.75529398
Na	1.93386239	7.61249780	13.75528327
Na	8.32885883	1.21732025	13.75531397
Na	8.32890259	7.61245493	13.75529238
Na	1.93377566	5.17543819	7.24469487
Na	1.93381902	11.57031071	7.24477232
Na	8.32882751	5.17546978	7.24470033
Na	8.32878519	11.57027970	7.24475987
Na	4.46100522	1.21938084	7.24474737
Na	4.46103539	7.61460578	7.24478433
Na	10.85602447	1.21940744	7.24472830
Na	10.85597593	7.61455523	7.24477184

### 3. LiP

64

P	0.92444137	4.15508741	9.30597490
P	0.92762938	10.61442474	9.30309546
P	7.38713477	4.15404042	9.30457784
P	7.39070304	10.61282678	9.30117904
P	4.15824401	5.53081035	9.31485196
P	4.15905048	11.99314297	9.31769356
P	10.61650315	5.52768140	9.31155180
P	10.61775440	11.99037507	9.31425922
P	0.92620320	2.30513143	10.69718931
P	0.92323306	8.76393161	10.69371056
P	7.38945644	2.30625145	10.69975162
P	7.38581042	8.76481399	10.69547994
P	2.30403908	5.52627888	10.68769950
P	2.30266507	11.98917715	10.68607834
P	8.76266541	5.52943183	10.68502370
P	8.76168601	11.99185876	10.68316860
P	5.53407942	4.15503266	10.69513496
P	5.53052836	10.61350916	10.69890029
P	11.99676206	4.15587831	10.69263592
P	11.99358498	10.61492955	10.69642972
P	4.15837603	0.92805358	10.68304570
P	4.15740216	7.39032495	10.68411418
P	10.61736755	0.93083625	10.68500514
P	10.61589516	7.39347616	10.68696628
P	5.52916924	2.30694563	9.30078614

P	5.53276143	8.76576926	9.30407452
P	11.99253485	2.30553973	9.30184432
P	11.99562533	8.76476311	9.30517722
P	2.30223160	0.92950358	9.31515968
P	2.30335503	7.39214167	9.31233234
P	8.76065777	0.92685213	9.31793404
P	8.76153487	7.38893495	9.31593242
Li	5.41014649	4.30477827	7.50865831
Li	5.42313323	10.80535833	7.50723719
Li	11.84086865	4.28958217	7.50071232
Li	11.84996620	10.78894619	7.49808296
Li	1.07003843	2.13062113	7.49813792
Li	1.07913138	8.63016037	7.50244695
Li	7.49675991	2.11436226	7.50801669
Li	7.50998232	8.61493233	7.50880559
Li	2.11610854	5.42330390	7.50731341
Li	2.13348632	11.85008377	7.49680726
Li	8.61608682	5.41042115	7.50807297
Li	8.63115026	11.84132347	7.50033167
Li	4.28868224	1.07836096	7.49967208
Li	4.30384627	7.50928618	7.50773967
Li	10.78629930	1.06976952	7.49613862
Li	10.80371989	7.49644266	7.50644605
Li	1.07936429	4.28952916	12.49955018
Li	1.07064862	10.78789521	12.50270346
Li	7.51083328	4.30453492	12.49215922
Li	7.49779370	10.80462408	12.49333188
Li	4.30453158	5.41110537	12.49064644
Li	4.28901730	11.84136360	12.49977276
Li	10.80495176	5.42404752	12.49212816
Li	10.78796866	11.85056086	12.50257836
Li	5.42214220	2.11506908	12.49287186
Li	5.40904051	8.61532762	12.49193032
Li	11.84931872	2.13171754	12.50233050
Li	11.84046797	8.63015728	12.49812586
Li	2.13200300	1.06927709	12.50385876
Li	2.11516930	7.49563389	12.49239068
Li	8.63107293	1.07826866	12.49955874
Li	8.61545752	7.50864575	12.49149530

#### 4. NaP

64

P	0.96780369	4.19584967	10.36823354
P	0.96780369	10.65584723	10.36823354
P	7.42780124	4.19584967	10.36823354
P	7.42780124	10.65584723	10.36823354
P	4.19703700	5.49371643	10.36818507
P	4.19703700	11.95371398	10.36818507
P	10.65703455	5.49371643	10.36818507
P	10.65703455	11.95371398	10.36818507
P	0.96625978	2.26308868	11.63331790
P	0.96625978	8.72308623	11.63331790
P	7.42625733	2.26308868	11.63331790
P	7.42625733	8.72308623	11.63331790
P	2.26399028	5.49242439	11.63289607
P	2.26399028	11.95242192	11.63289607

P	8.72398783	5.49242439	11.63289607
P	8.72398783	11.95242192	11.63289607
P	5.49373777	4.19745143	11.63297586
P	5.49373777	10.65744898	11.63297586
P	11.95373532	4.19745143	11.63297586
P	11.95373532	10.65744898	11.63297586
P	4.19569794	0.96789252	11.63332657
P	4.19569794	7.42789007	11.63332657
P	10.65569549	0.96789252	11.63332657
P	10.65569549	7.42789007	11.63332657
P	5.49224571	2.26416113	10.36890324
P	5.49224571	8.72415869	10.36890324
P	11.95224325	2.26416113	10.36890324
P	11.95224325	8.72415869	10.36890324
P	2.26272351	0.96628112	10.36843420
P	2.26272351	7.42627867	10.36843420
P	8.72272106	0.96628112	10.36843420
P	8.72272106	7.42627867	10.36843420
Na	5.17284181	4.52356336	7.37332148
Na	5.17284181	10.98356091	7.37332148
Na	11.63283936	4.52356336	7.37332148
Na	11.63283936	10.98356091	7.37332148
Na	1.28650542	1.93632978	7.37366842
Na	1.28650542	8.39632733	7.37366842
Na	7.74650297	1.93632978	7.37366842
Na	7.74650297	8.39632733	7.37366842
Na	1.93908050	5.17057380	7.37294128
Na	1.93908050	11.63057134	7.37294128
Na	8.39907805	5.17057380	7.37294128
Na	8.39907805	11.63057134	7.37294128
Na	4.52144586	1.29032374	7.37358427
Na	4.52144586	7.75032130	7.37358427
Na	10.98144341	1.29032374	7.37358427
Na	10.98144341	7.75032130	7.37358427
Na	1.28972865	4.52088331	14.62704550
Na	1.28972865	10.98088086	14.62704550
Na	7.74972620	4.52088331	14.62704550
Na	7.74972620	10.98088086	14.62704550
Na	4.52388484	5.17307716	14.62692529
Na	4.52388484	11.63307471	14.62692529
Na	10.98388239	5.17307716	14.62692529
Na	10.98388239	11.63307471	14.62692529
Na	5.16931456	1.93839274	14.62691737
Na	5.16931456	8.39839031	14.62691737
Na	11.62931211	1.93839274	14.62691737
Na	11.62931211	8.39839031	14.62691737
Na	1.93667966	1.28763187	14.62677030
Na	1.93667966	7.74762942	14.62677030
Na	8.39667720	1.28763187	14.62677030
Na	8.39667720	7.74762942	14.62677030

## 5. $Li_2P$

96

P	0.93347081	4.16085031	11.81436570
P	0.93340335	10.61614382	11.81544325
P	7.39128886	4.16205667	11.81407260

P	7.39110932	10.61707761	11.81517425
P	4.16345588	5.53016740	11.81123192
P	4.16225261	11.98841511	11.81099682
P	10.61783284	5.53034199	11.81148494
P	10.61682946	11.98844084	11.81147027
P	0.93284454	2.30156582	13.18221282
P	0.93298723	8.75674534	13.18250662
P	7.39049217	2.30067254	13.18249532
P	7.39078764	8.75572139	13.18287197
P	2.30263093	5.52824807	13.18253849
P	2.30379381	11.98641769	13.18249707
P	8.75699127	5.52812023	13.18341079
P	8.75833497	11.98635014	13.18352249
P	5.52931870	4.16413026	13.18041388
P	5.52930532	10.61939639	13.17988103
P	11.98715056	4.16303844	13.17957151
P	11.98699760	10.61849940	13.17922063
P	4.16224386	0.93382955	13.18172520
P	4.16370469	7.39112264	13.18202759
P	10.61690675	0.93372843	13.18133790
P	10.61808434	7.39086814	13.18131240
P	5.52980002	2.30253268	11.81360958
P	5.52938254	8.75745417	11.81305773
P	11.98703600	2.30342614	11.81370911
P	11.98679942	8.75863584	11.81314536
P	2.30297851	0.93163123	11.81411808
P	2.30195695	7.38917344	11.81406123
P	8.75775791	0.93155426	11.81398301
P	8.75641568	7.38933518	11.81368686
Li	5.43293207	4.28353182	9.85377237
Li	5.42672676	10.69834252	9.85358889
Li	11.88596267	4.28199628	9.85299604
Li	11.87924135	10.69899976	9.85227045
Li	1.03784849	2.22011357	9.85262405
Li	1.03181316	8.63726901	9.85348184
Li	7.49310036	2.22094221	9.85380689
Li	7.48715082	8.63587970	9.85413994
Li	2.22135667	5.42633060	9.85395912
Li	2.22208294	11.87334726	9.85251372
Li	8.63627658	5.43220341	9.85415546
Li	8.63919793	11.87951437	9.85328422
Li	4.28053261	1.03860497	9.85308115
Li	4.28339313	7.48752950	9.85407099
Li	10.69757545	1.04512163	9.85224262
Li	10.69829060	7.49354319	9.85371177
Li	1.04092732	4.28164617	15.14468572
Li	1.04739340	10.69810946	15.14553197
Li	7.48815408	4.28393378	15.14379893
Li	7.49420055	10.69842203	15.14404730
Li	4.28457779	5.43208141	15.14355818
Li	4.28354723	11.88750368	15.14435882
Li	10.69947700	5.42616174	15.14370978
Li	10.70062368	11.88156326	15.14514007
Li	5.42581101	2.22154765	15.14401062
Li	5.43174181	8.63601257	15.14359418
Li	11.87756081	2.22152279	15.14534827
Li	11.88374524	8.63798641	15.14438097
Li	2.22059631	1.04156710	15.14560224

Li	2.22137774	7.49376927	15.14413330
Li	8.63731834	1.03500796	15.14486180
Li	8.63605411	7.48758696	15.14393425
Li	2.12341652	5.32833605	17.64678335
Li	2.11894018	11.81388126	17.64382261
Li	8.54179703	5.33040683	17.64903101
Li	8.53608263	11.81305200	17.64625338
Li	1.10488952	2.11840760	17.64390171
Li	1.10520211	8.53470598	17.64653572
Li	7.59161364	2.12307495	17.64670950
Li	7.58929847	8.54053370	17.64938539
Li	5.33074162	4.37936607	17.64943654
Li	5.32840980	10.79674002	17.64651275
Li	11.81602328	4.38518202	17.64653292
Li	11.81621049	10.80135557	17.64366679
Li	4.38451737	1.10620075	17.64653673
Li	4.37881111	7.58933917	17.64914349
Li	10.80133380	1.10577277	17.64388271
Li	10.79681503	7.59154571	17.64663500
Li	4.37884734	5.33035587	7.35047287
Li	4.38527591	11.81749074	7.35312911
Li	10.79725848	5.32806346	7.35295288
Li	10.80236394	11.81768126	7.35530752
Li	1.10592592	4.38345426	7.35313256
Li	1.10494869	10.80145390	7.35503165
Li	7.58994608	4.37753388	7.35061864
Li	7.59189114	10.79678225	7.35257704
Li	5.32803252	2.12299627	7.35259609
Li	5.33006788	8.54202360	7.35055185
Li	11.81637234	2.11811772	7.35494885
Li	11.81573539	8.53591896	7.35310278
Li	2.11776960	1.10165420	7.35536835
Li	2.12284819	7.59159886	7.35309321
Li	8.53494040	1.10191592	7.35297281
Li	8.54133746	7.58945824	7.35045682

## 6. $Na_2P$

96

P	0.97293911	4.20338599	12.86941168
P	0.97295616	10.66351802	12.86942113
P	7.43294304	4.20341405	12.86940639
P	7.43292013	10.66349628	12.86942161
P	4.20457332	5.48639478	12.85611842
P	4.20456395	11.94635938	12.85611270
P	10.66471261	5.48639016	12.85609580
P	10.66471883	11.94636507	12.85611329
P	0.97170470	2.25695264	14.14425350
P	0.97170917	8.71707421	14.14426144
P	7.43167082	2.25696208	14.14421991
P	7.43167351	8.71705978	14.14425774
P	2.25804273	5.48833044	14.13150316
P	2.25805958	11.94830098	14.13149493
P	8.71819267	5.48835312	14.13152500
P	8.71817657	11.94827361	14.13149382
P	5.48848857	4.20240634	14.11776082
P	5.48848121	10.66252215	14.11776365
P	11.94845002	4.20240717	14.11777013

P 11.94846390 10.66252034 14.11775706  
P 4.20044651 0.97203135 14.12949172  
P 4.20047101 7.43199782 14.12951186  
P 10.66061005 0.97204767 14.12950241  
P 10.66058677 7.43197991 14.12953362  
P 5.48587536 2.25726099 12.86799793  
P 5.48589277 8.71738632 12.86797668  
P 11.94588601 2.25727896 12.86798351  
P 11.94586019 8.71736876 12.86797031  
P 2.25483810 0.97319161 12.88191086  
P 2.25484213 7.43317212 12.88188786  
P 8.71498556 0.97319939 12.88191051  
P 8.71498045 7.43316959 12.88186396  
Na 5.26658672 4.42940936 10.14829778  
Na 5.26660056 10.88948097 10.14830782  
Na 11.72661286 4.42940795 10.14826317  
Na 11.72658986 10.88949678 10.14831630  
Na 1.19341366 2.02886381 10.15279274  
Na 1.19341338 8.48889817 10.15278061  
Na 7.65333856 2.02885054 10.15281504  
Na 7.65332925 8.48893104 10.15273277  
Na 2.03686705 5.25939883 10.15060182  
Na 2.03682233 11.71942390 10.15061187  
Na 8.49672334 5.25935952 10.15055430  
Na 8.49677447 11.71945453 10.15063201  
Na 4.42253634 1.19923564 10.15081807  
Na 4.42250028 7.65922081 10.15077255  
Na 10.88244664 1.19919375 10.15082376  
Na 10.88249991 7.65927094 10.15074311  
Na 1.19936025 4.42212087 16.85364997  
Na 1.19931781 10.88215034 16.85362467  
Na 7.65920726 4.42206460 16.85367105  
Na 7.65925950 10.88220042 16.85363585  
Na 4.42989641 5.26643401 16.85212347  
Na 4.42990136 11.72650275 16.85211302  
Na 10.88984629 5.26642455 16.85217563  
Na 10.88982555 11.72650350 16.85208651  
Na 5.26180910 2.03729608 16.85254043  
Na 5.26176741 8.49731546 16.85257696  
Na 11.72173778 2.03724314 16.85255037  
Na 11.72179300 8.49734968 16.85257837  
Na 2.03146928 1.19239907 16.85551337  
Na 2.03146190 7.65242825 16.85551407  
Na 8.49135045 1.19239849 16.85548343  
Na 8.49134577 7.65244511 16.85557596  
Na 2.03942404 5.26790673 20.12148583  
Na 2.03939970 11.72794102 20.12146755  
Na 8.49929172 5.26790007 20.12148936  
Na 8.49931406 11.72795242 20.12145516  
Na 1.19291418 2.03845094 20.12170396  
Na 1.19291551 8.49848211 20.12171328  
Na 7.65284670 2.03845471 20.12168009  
Na 7.65283766 8.49847365 20.12172151  
Na 5.27070447 4.42173146 20.11950176  
Na 5.27070624 10.88176984 20.11950646  
Na 11.73068213 4.42172623 20.11953281  
Na 11.73068335 10.88177702 20.11950821  
Na 4.42326658 1.19228608 20.12079017

Na	4.42324766	7.65227192	20.12082851
Na	10.88317423	1.19227105	20.12081450
Na	10.88318742	7.65228718	20.12084431
Na	4.42267273	5.26777702	6.87831294
Na	4.42267412	11.72781281	6.87832301
Na	10.88260947	5.26778225	6.87829374
Na	10.88261386	11.72782188	6.87832617
Na	1.19238179	4.41917906	6.87907218
Na	1.19236604	10.87920948	6.87908157
Na	7.65230310	4.41917952	6.87906319
Na	7.65231993	10.87922501	6.87907887
Na	5.26394804	2.03823779	6.87897125
Na	5.26393581	8.49823781	6.87894549
Na	11.72391653	2.03822818	6.87896037
Na	11.72393093	8.49826441	6.87893982
Na	2.03416050	1.18836594	6.88085955
Na	2.03416996	7.64837447	6.88085318
Na	8.49407045	1.18836460	6.88087812
Na	8.49406923	7.64837898	6.88082950