Electronic Supplementary Information

**The Deposition of Cadmium Selenide and Cadmium Phosphide Thin Films from Cadmium Thioselenoimidodiphosphinate by AACVD and the Formation of Aromatic Species**

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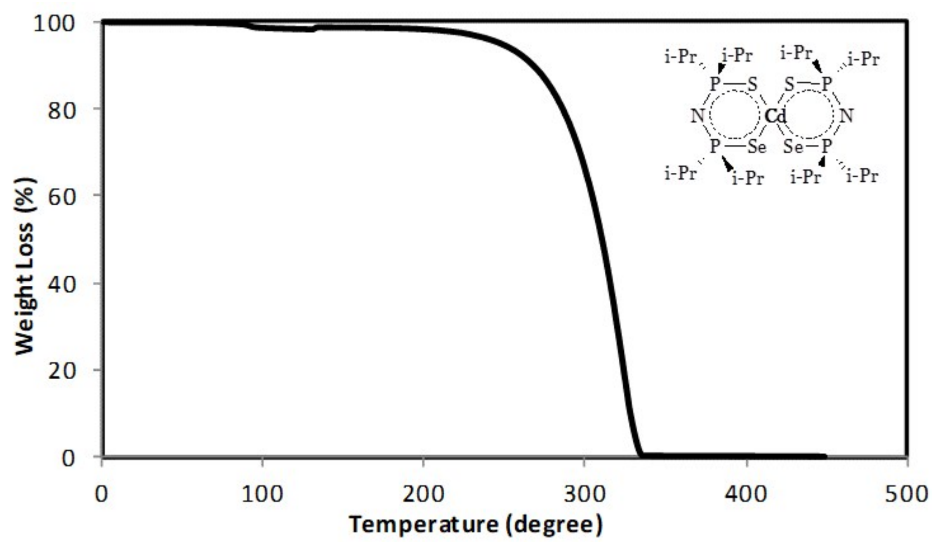


**Figure S1.** Thermogravimetry analysis of $Cd[(SP^{i}Pr_2)(SeP^{i}Pr_2)_2N]_2$. Inset shows the structure of precursor.

| Compound | Dep. Temp (°C) | Flow Rate (sccm) | Phase | Lattice Constant (Å) | |
|---|---|---|---|---|---|
| | | | | **Experimental** | **Literature[1,2]** |
| **CdSe** | 525/500 | 240 | Hexagonal | *a* = 4.290(3)<br>*c* = 7.013(3) | *a* = 4.299<br>*c* = 7.010 |
| **$CdSe/Cd_2P_3$** | 500/475 | 160 | Monoclinic | *a* = 18.035(1)<br>*b* = 4.610(3)<br>*c* = 17.854(2) | *a* = 18.030<br>*b* = 4.610<br>*c* = 17.850 |

**Table S1.** Lattice parameters of the deposited thin films .

| Compound | Dep. Temp (°C) | Flow Rate (sccm) | Cd (%) | Se (%) | P (%) |
|---|---|---|---|---|---|
| **CdSe** | 525<br>500 | 240<br>240 | 39.3<br>42.4 | 30.6<br>34.2 | 29.8<br>22.7 |
| **$CdSe/Cd_2P_3$** | 500<br>475 | 160<br>160 | 43.4<br>37.2 | 33.9<br>34.9 | 22.5<br>27.1 |

**Table S2.** Compositional analysis of films determined by EDAX.

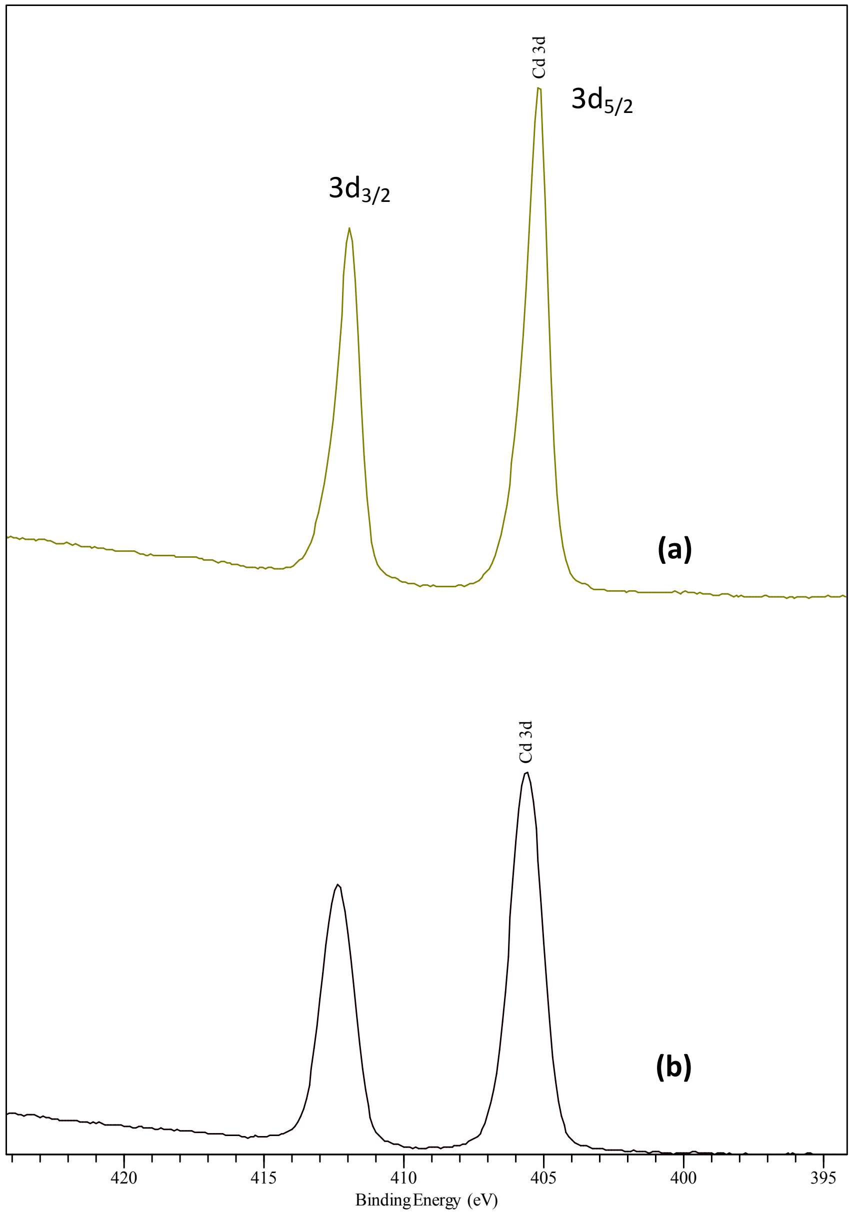


**Figure S2.** XPS of Cd 3d peaks of (a) $Cd[(SP^{i}Pr_2)(SeP^{i}Pr_2)_2N]_2$ and (b) $Cd[(SeP^{i}Pr_2)_2N]_2$[3].

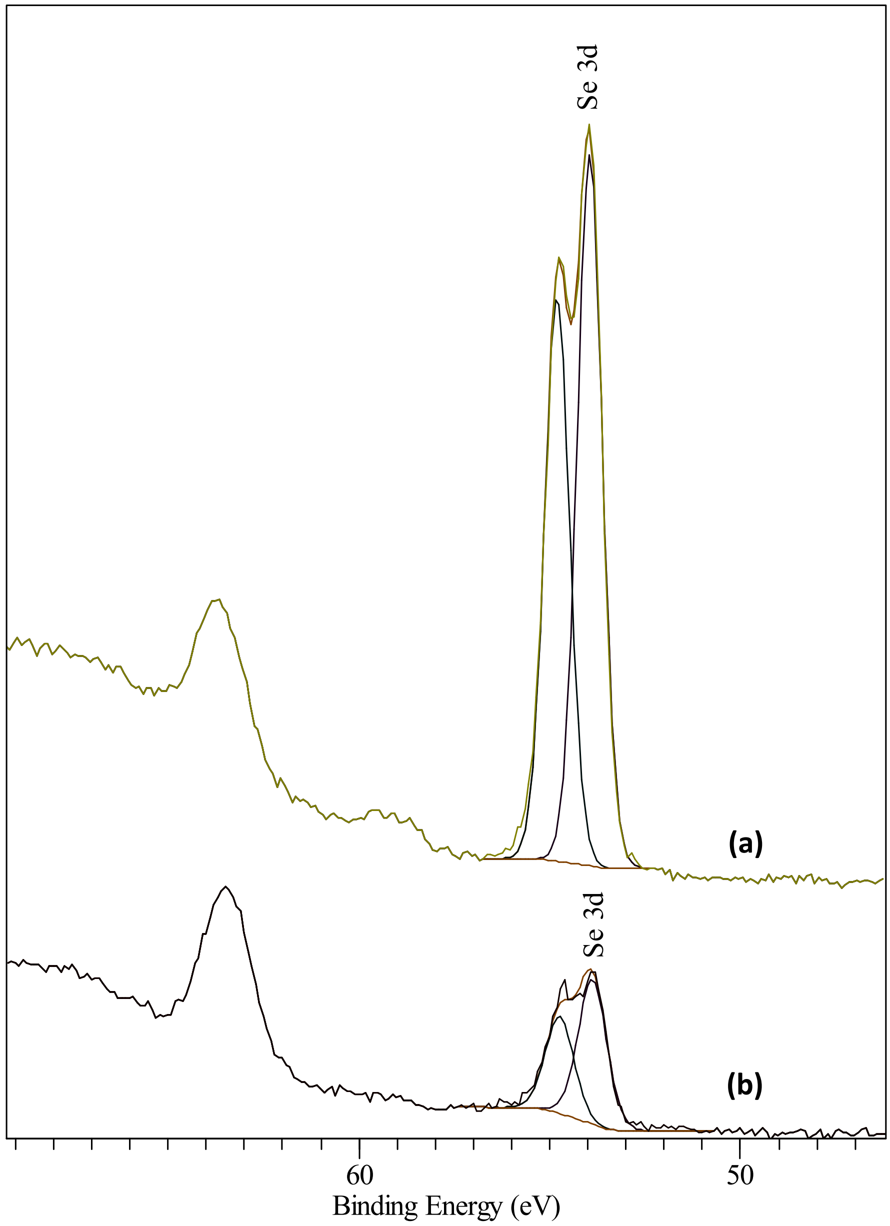


**Figure S3.** XPS of Se 3d peaks of (a) Cd[(SP$^{i}$Pr$_2$)(SeP$^{i}$Pr$_2$)$_2$N]$_2$ and (b) Cd[(SeP$^{i}$Pr$_2$)$_2$N]$_2$[3].

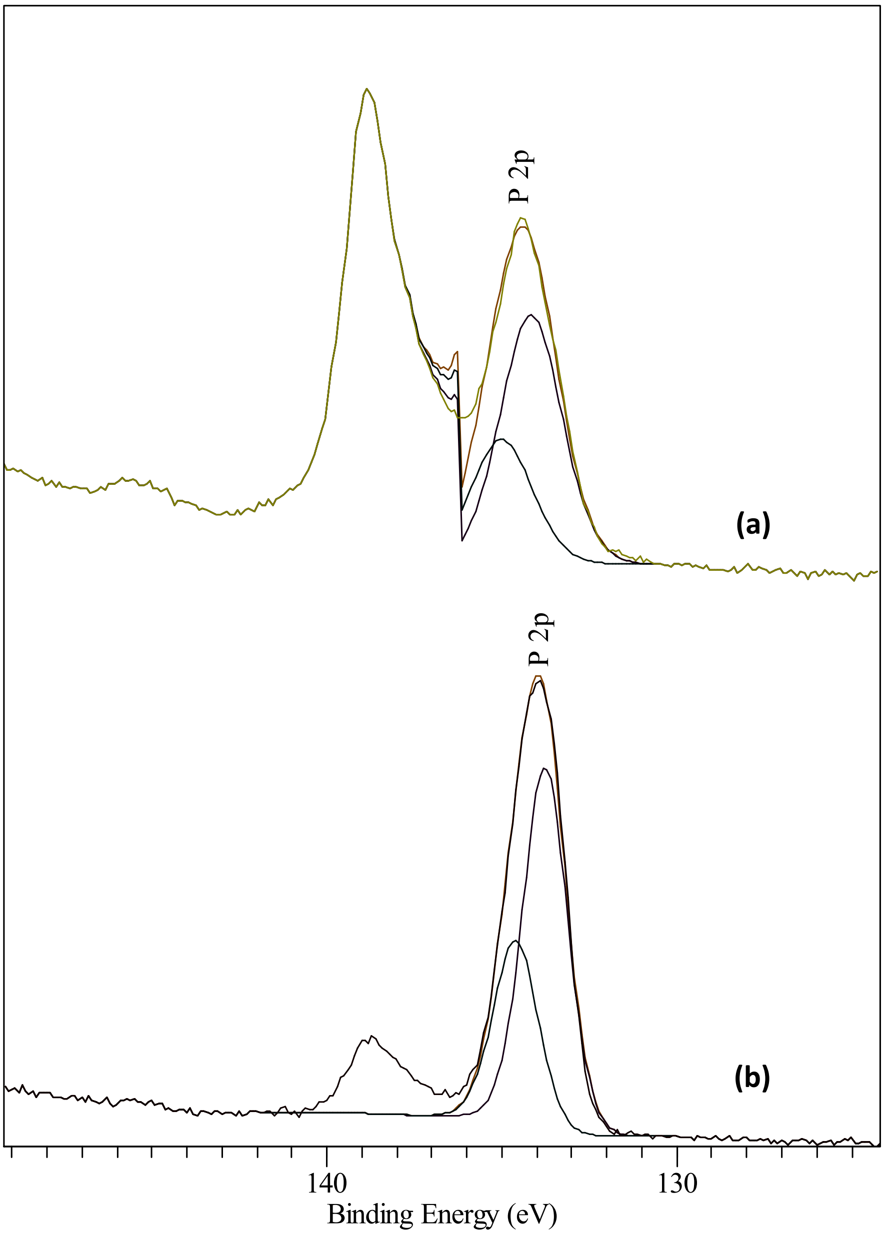


**Figure S4.** XPS of P 2p peaks of (a) Cd[(SP$^i$Pr$_2$)(SeP$^i$Pr$_2$)$_2$N]$_2$ and (b) Cd[(SeP$^i$Pr$_2$)$_2$N]$_2$[3].

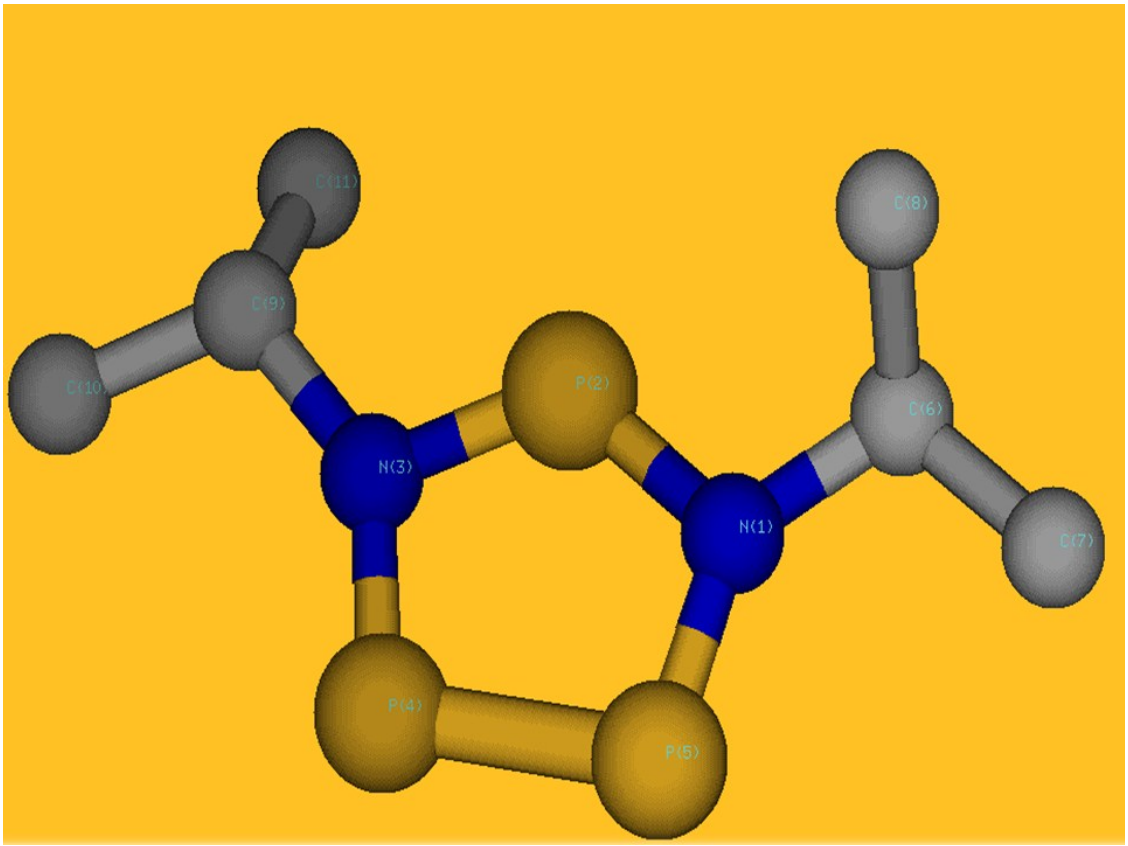


**Figure. S5.** The aromatic ion found in our previous study, at a charge to mass ratio of 207 in the MS. We assigned it this structure due to its stability. For clarity the hydrogens are omitted[4].

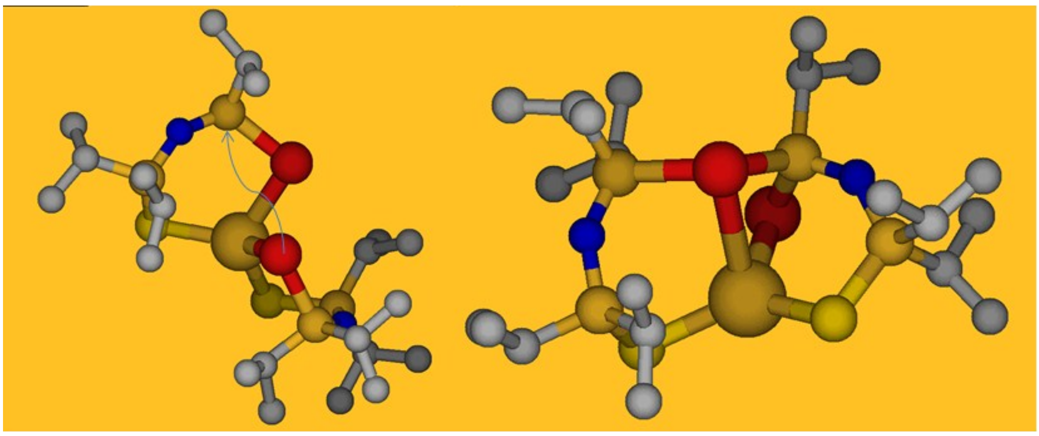

**Figure. S6.** The $Cd[(SP^{i}Pr_{2})(SeP^{i}Pr)N][(SP^{i}Pr_{2})(SeP^{i}Pr_{2})N]^{+}$ ion**,** which is the parent ion with the loss of an *iso*-propyl group from P bound to Se (shown in Red). The Se from the other complete ligand attacks the trivalent P as indicated by the arrow in the left image, to yield the structure shown on the right. For clarity the hydrogens have been omitted[4].

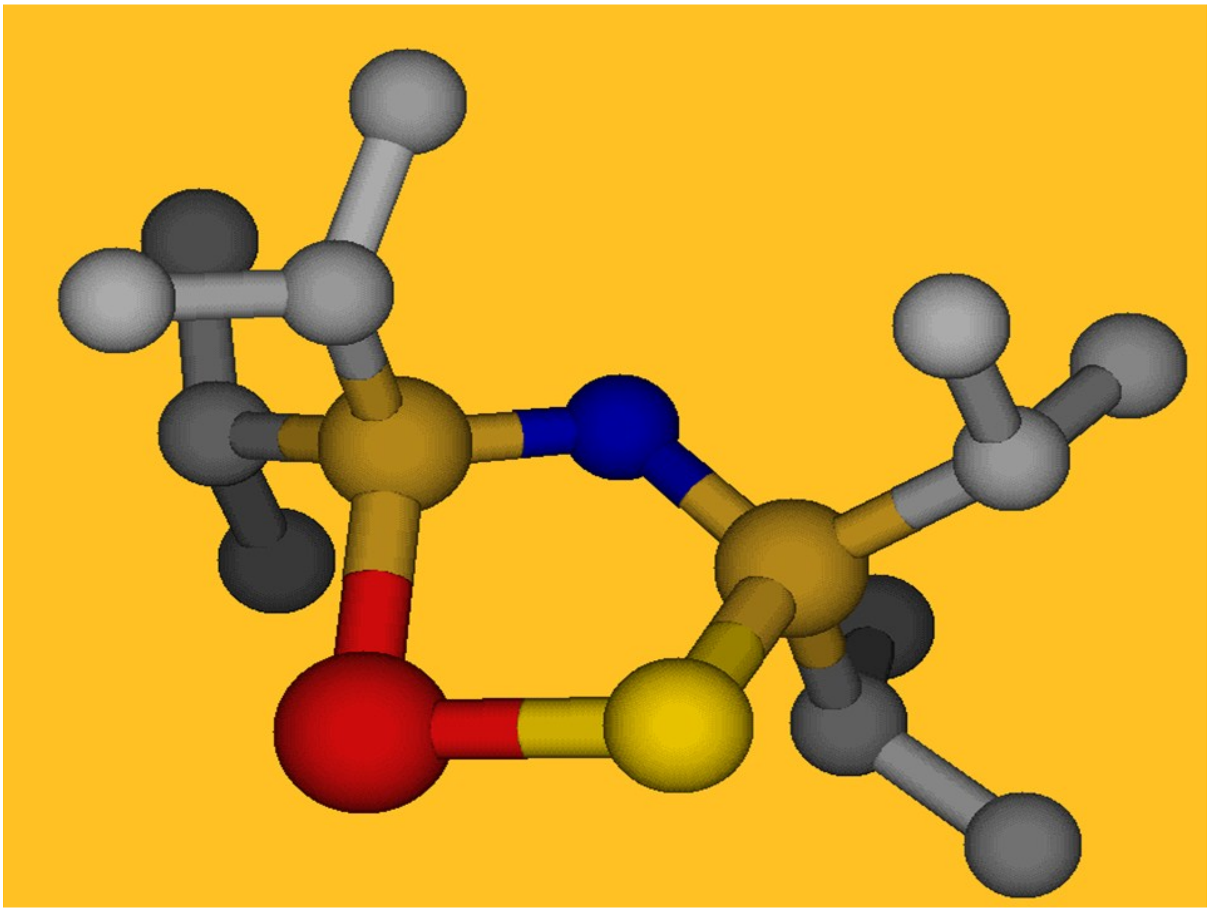

**Figure S7.** The stable ion ($SP^iPr_2$)($SeP^iPr_2$)$_2$N$^+$ formed by the loss of an entire ligand from the ionized complex Cd[($SP^iPr_2$)($SeP^iPr_2$)$_2$N]$_2^+$ (formed during MS analysis). Once this ligand has been lost from the complex, it spontaneously cyclized as this results in each element being in a stable valence state. Thus with the positive charge on N, this forms two double bonds to each P and these in turn form two bonds to the *iso*-propyl groups and one bond to either S or Se, giving two five valent P atoms. The Se and S form a bond to each other to complete the cyclization of the ion and to give them two single bonds each. For clarity the hydrogens have been omitted[4].

**References:**

1. (a) T. Logu, K. Sankarasubramanian, P. Soundarrajan and K. Sethuraman, *Elect. Mater. Lett.,* 2015, **Vol 11, No 2,** 206-212. (b) H. Chauhan, Y. Kumar and S. Deka, *Nanoscale.,* 2014, **6,** 10347-10354.

2. D. Oyetunde, M. Afzaal, M. A. Vincent, I. H. Hillier and P. O'Brien, *Inorg. Chem.,* 2011, **50,** 2052.

3. T. Oyetunde, M. Afzaal, M. A. Vincent and P. O'Brien, *Dalton Trans.,* 2016, **45,** 18603.

4. G. Schaftenaar, E. Vlieg and G. Vriend,"Molden 2.0: quantum chemistry meets proteins", *J Comput Aided Mol. Des.*, **2017**, 31, 789. G.Schaftenaar and J.H. Noordik, "Molden: a pre- and post-processing program for molecular and electronic structures", *J. Comput.-Aided Mol. Design*, 2000, **14**, 123-134.