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Supplementary Information

Synthesis and tetra-pincer nickel(II) and palladium(II) complexes of resorcin[4]arene-octophosphinite [Res(OPR$_2$)$_8$] and rhodium-catalyzed regioselective hydroformylation reaction

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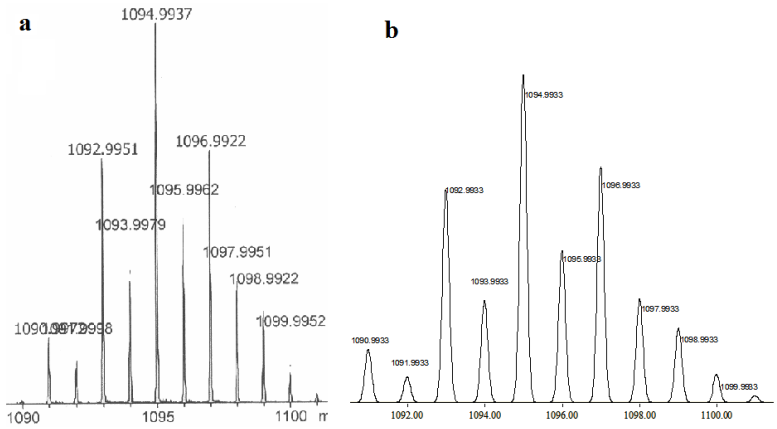

Fig. S1 High-resolution ESI-MS of **2** $[M+3Na–2H]^+$ (a) observed and (b) simulated spectra.

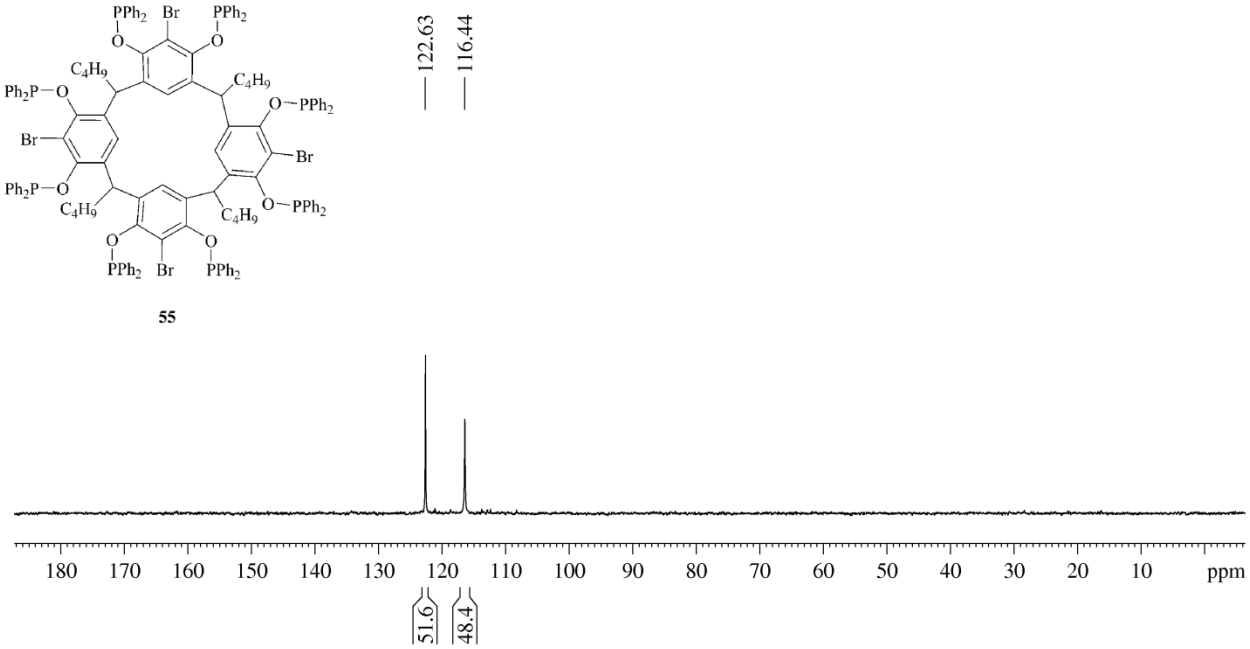

Fig. S2 $^{31}P\{^1H\}$ NMR spectrum of **3** in $CDCl_3$ (162 MHz).

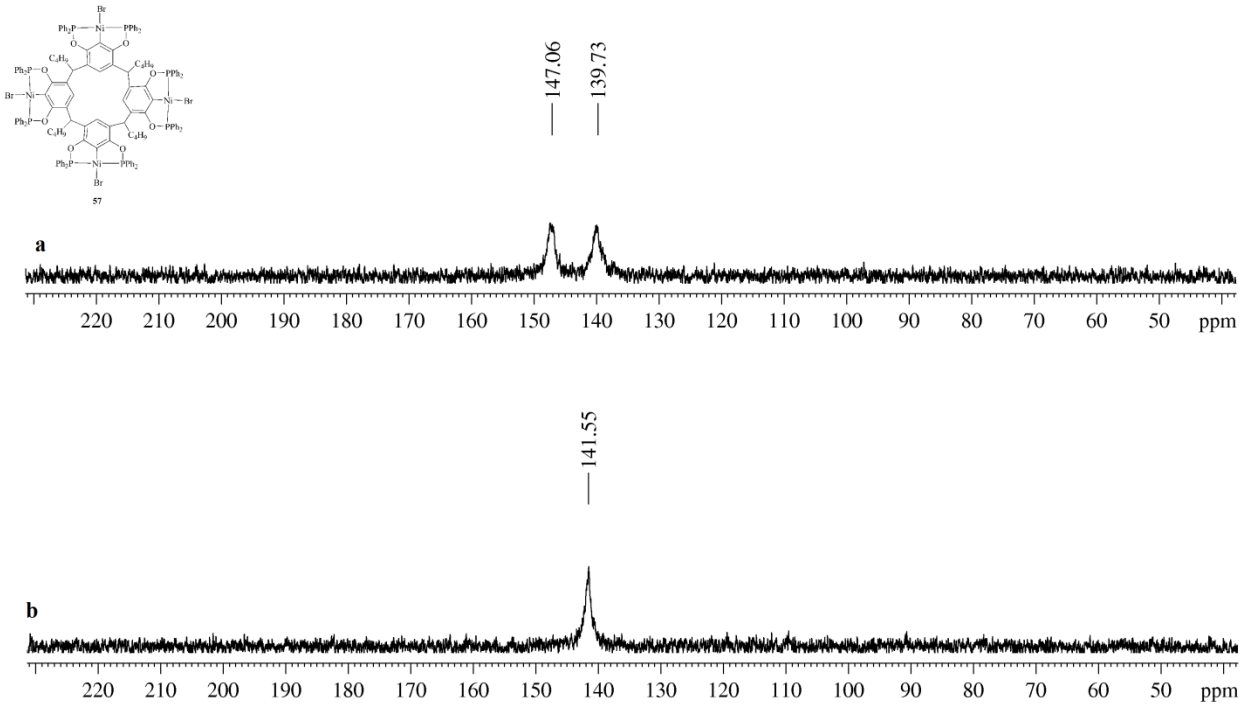

Fig. S3 $^{31}P\{^{1}H\}$ NMR spectrum of **5**, a) –20 °C and b) 25 °C in $CDCl_3$ (162 MHz).

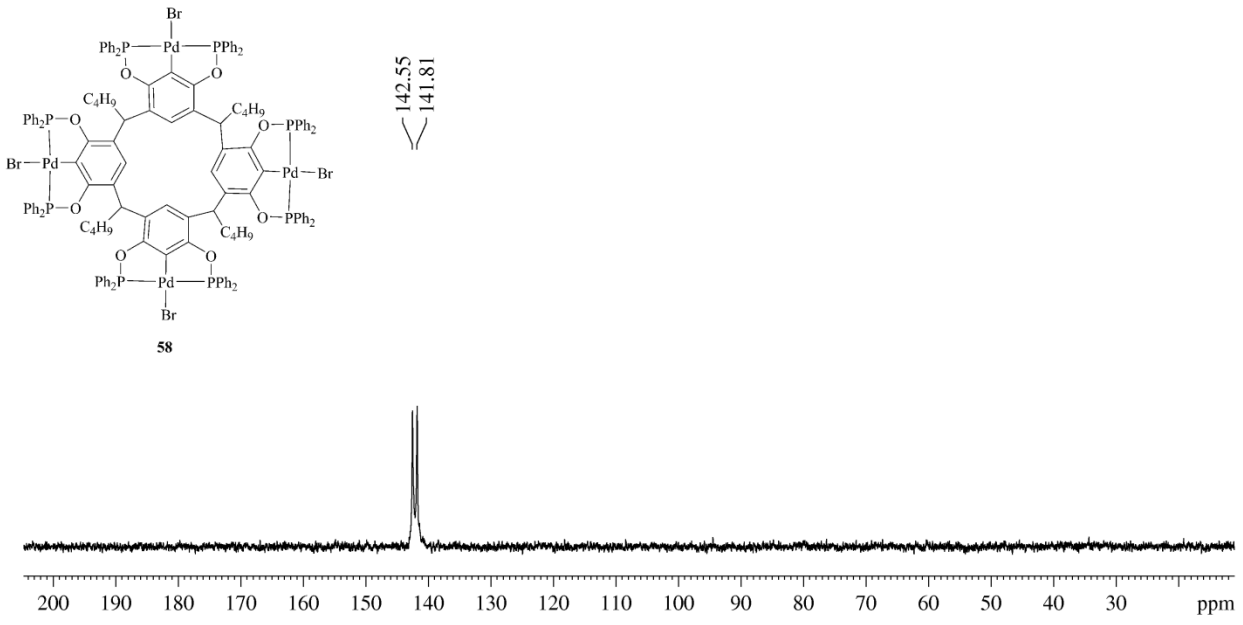

Fig. S4 $^{31}P\{^{1}H\}$ NMR spectrum of **6** in $CDCl_3$ (162 MHz).

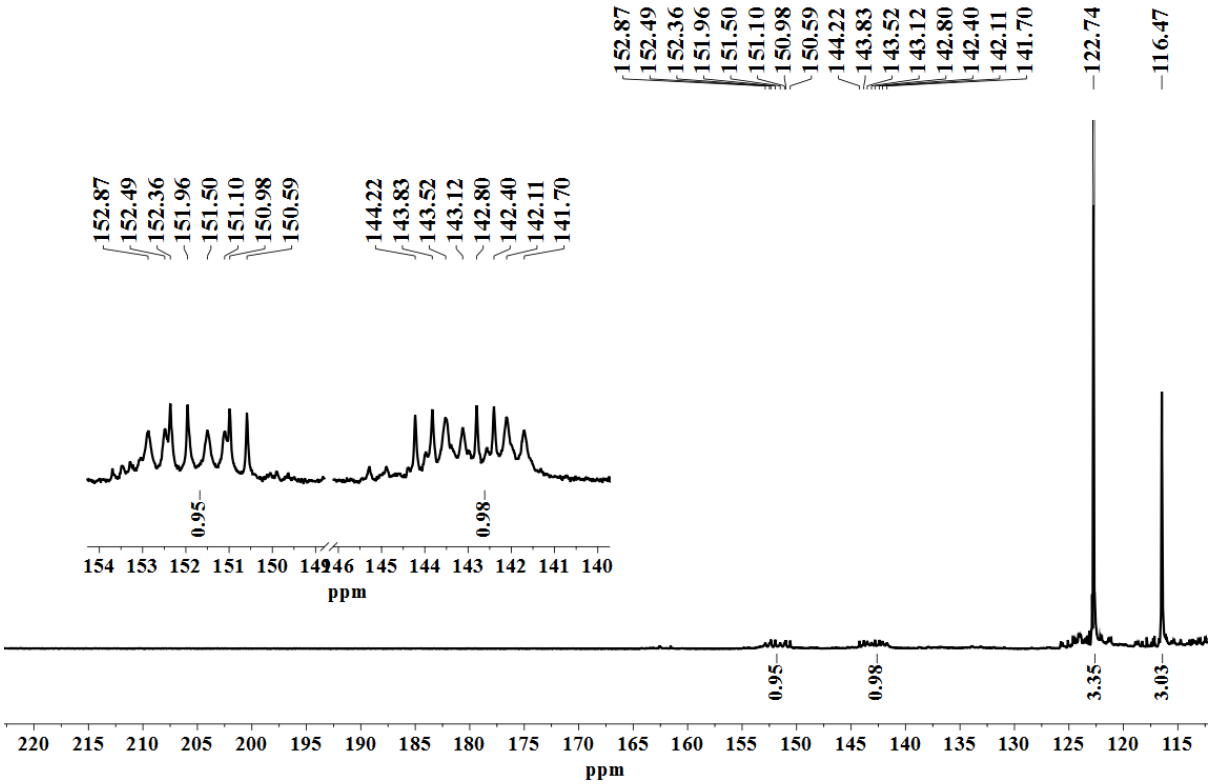

Fig. S5 $^{31}P\{^{1}H\}$ NMR spectrum of **7** in $CDCl_3$ (162 MHz).

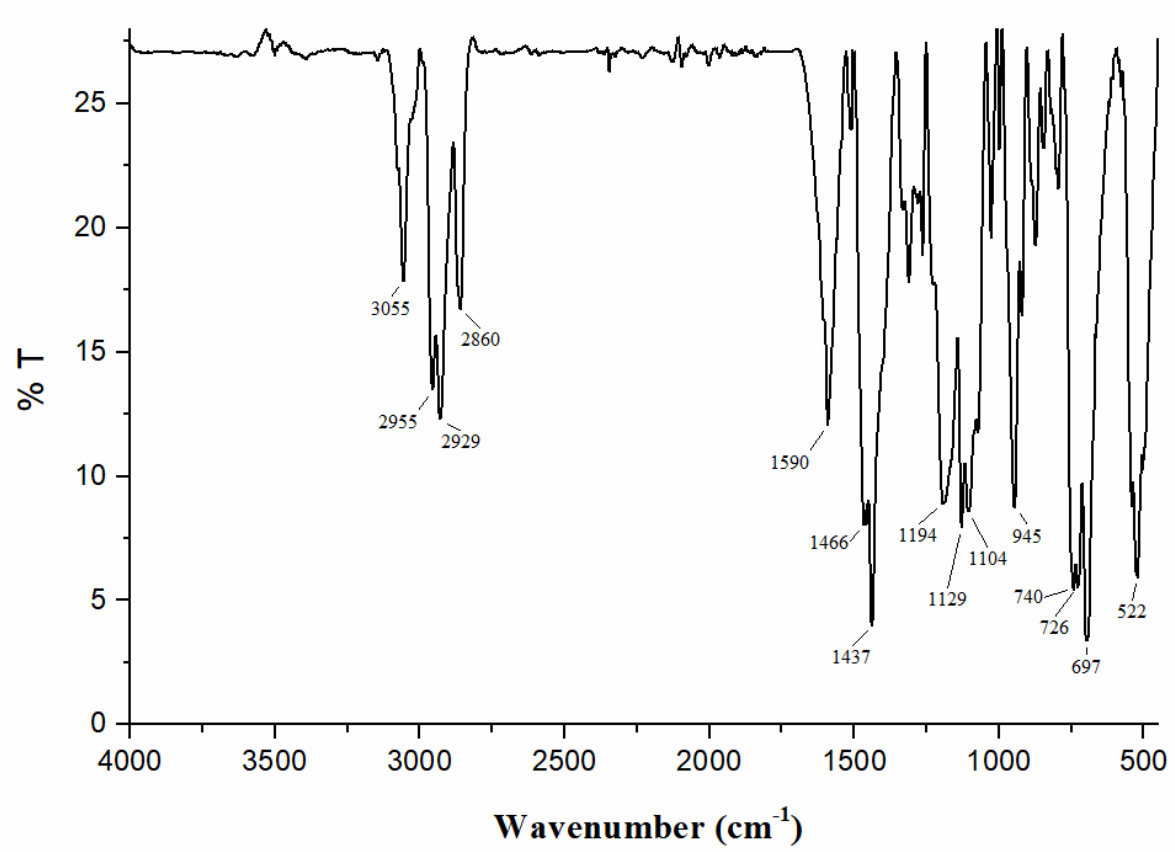

Fig. S6 IR spectrum of **7**

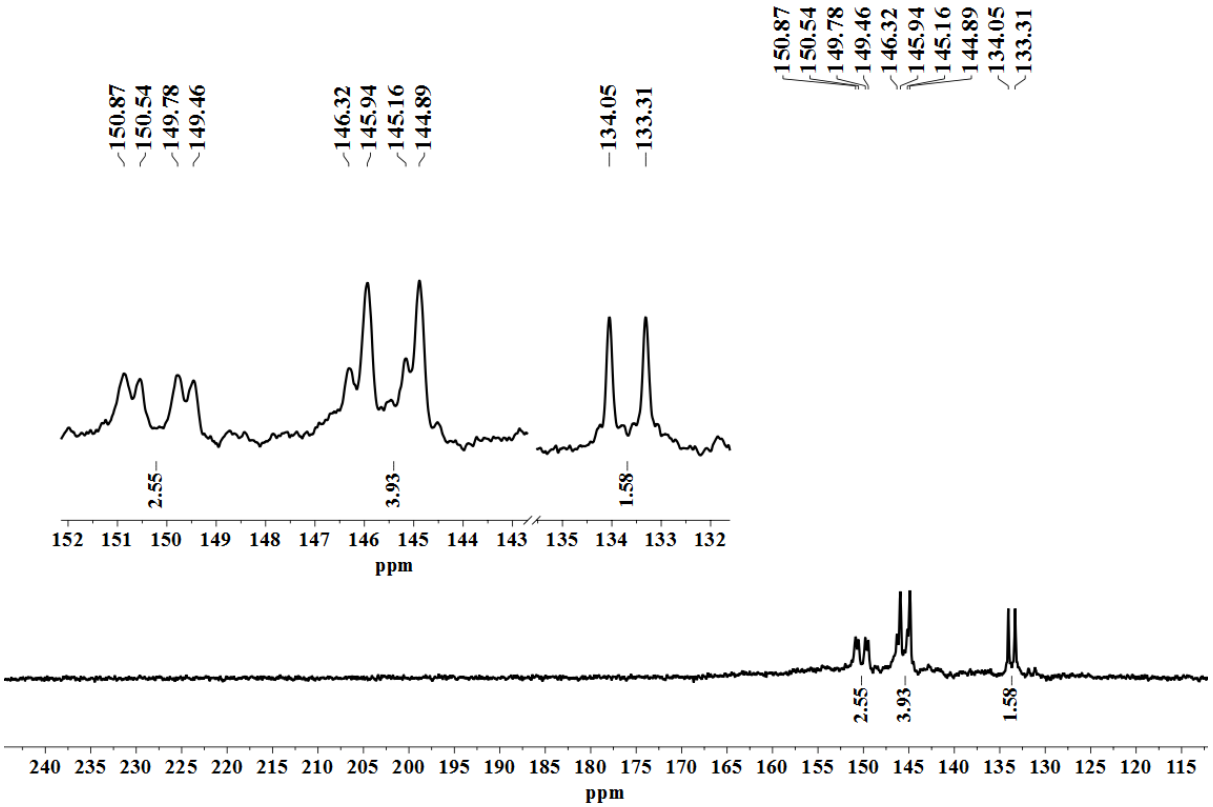

Fig. S7 $^{31}P\{^{1}H\}$ NMR spectrum of **8** in $CDCl_3$ (162 MHz).

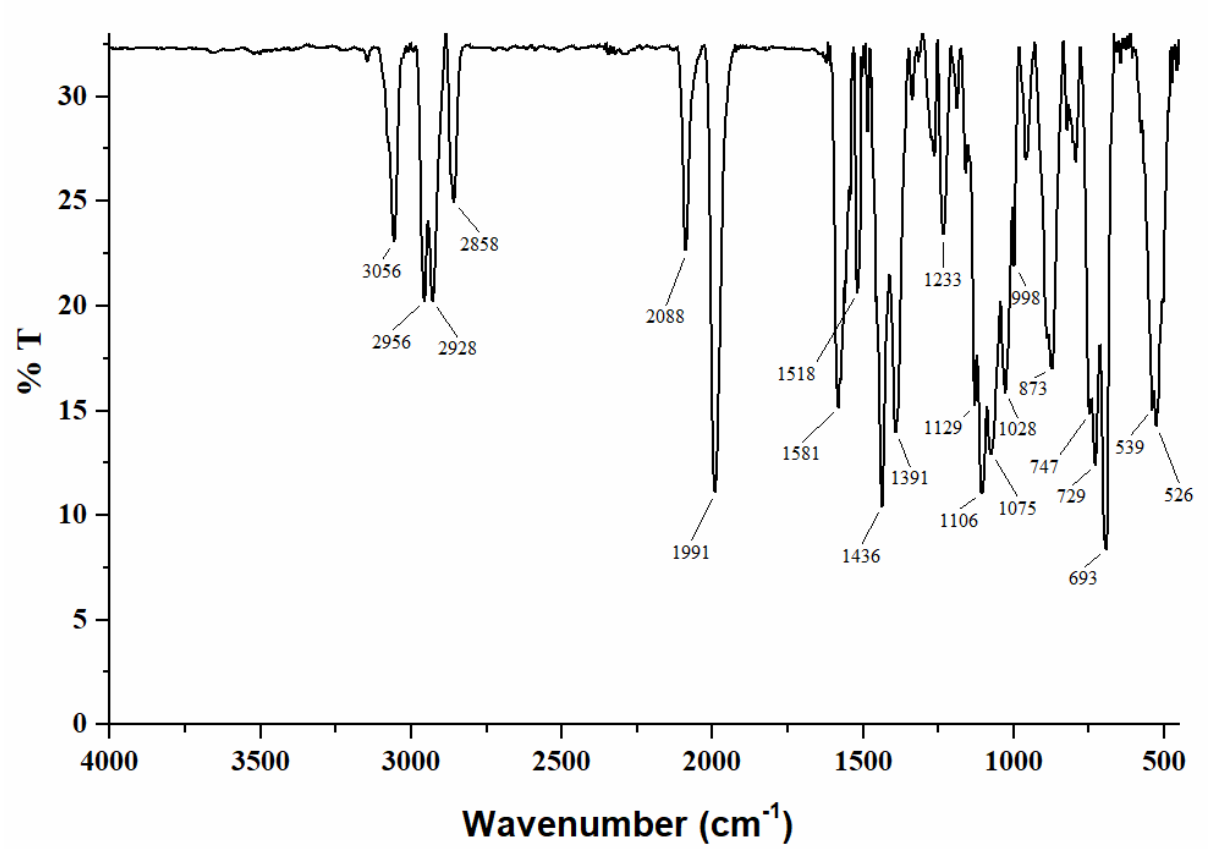

Fig. S8 IR spectrum of **8**

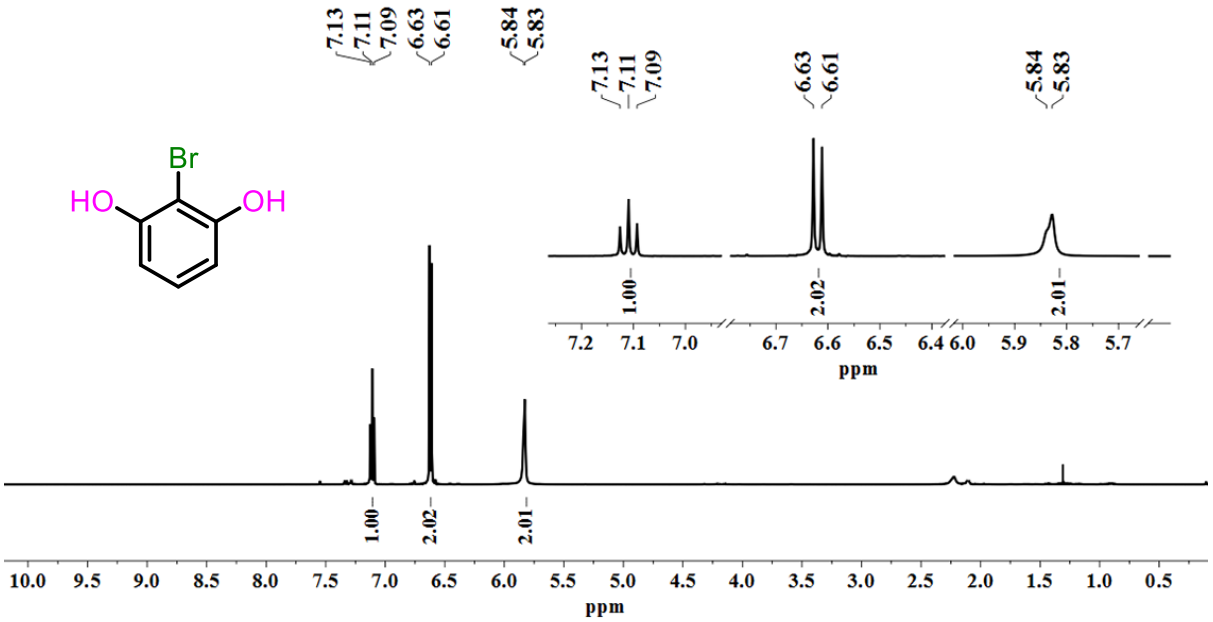

Fig. S9 ^{1}H NMR spectrum of **10** in $CDCl_3$ (500 MHz).

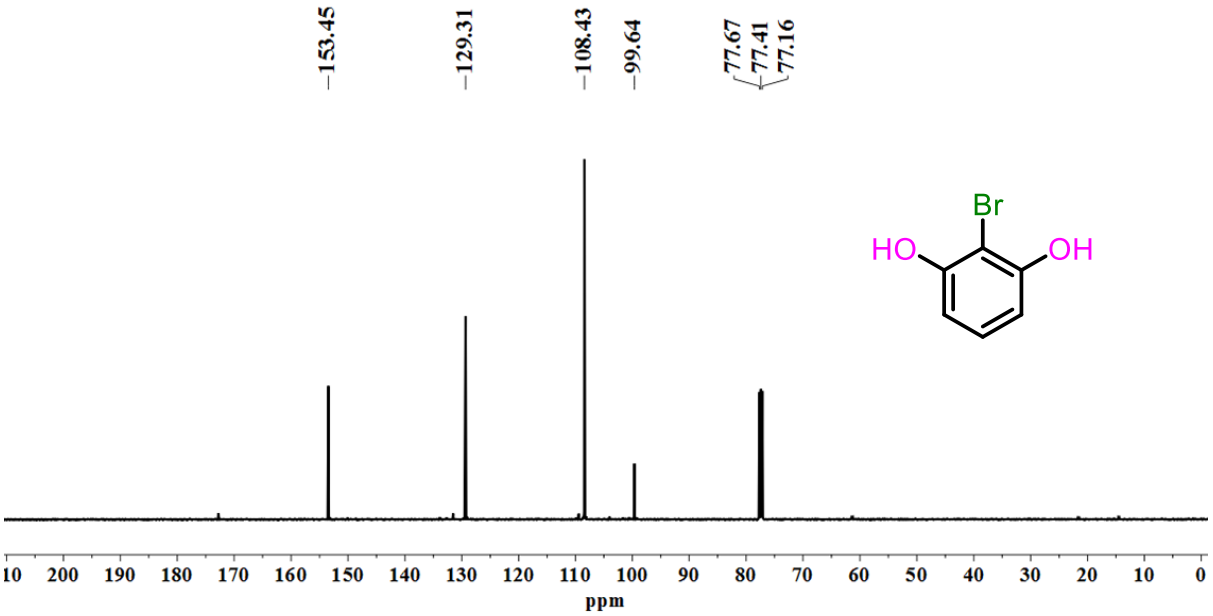

Fig. S10 $^{13}C\{^{1}H\}$ NMR spectrum of **10** in $CDCl_3$ (126 MHz).

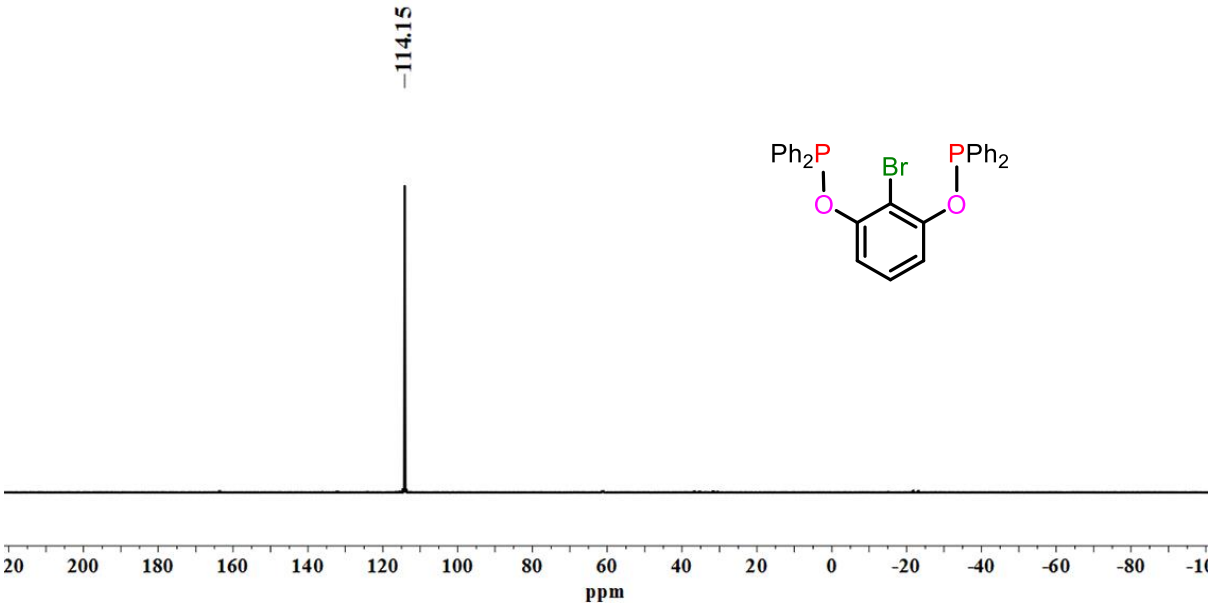

Fig. S11 $^{31}P\{^{1}H\}$ NMR spectrum of **11** in $CDCl_3$ (162 MHz).

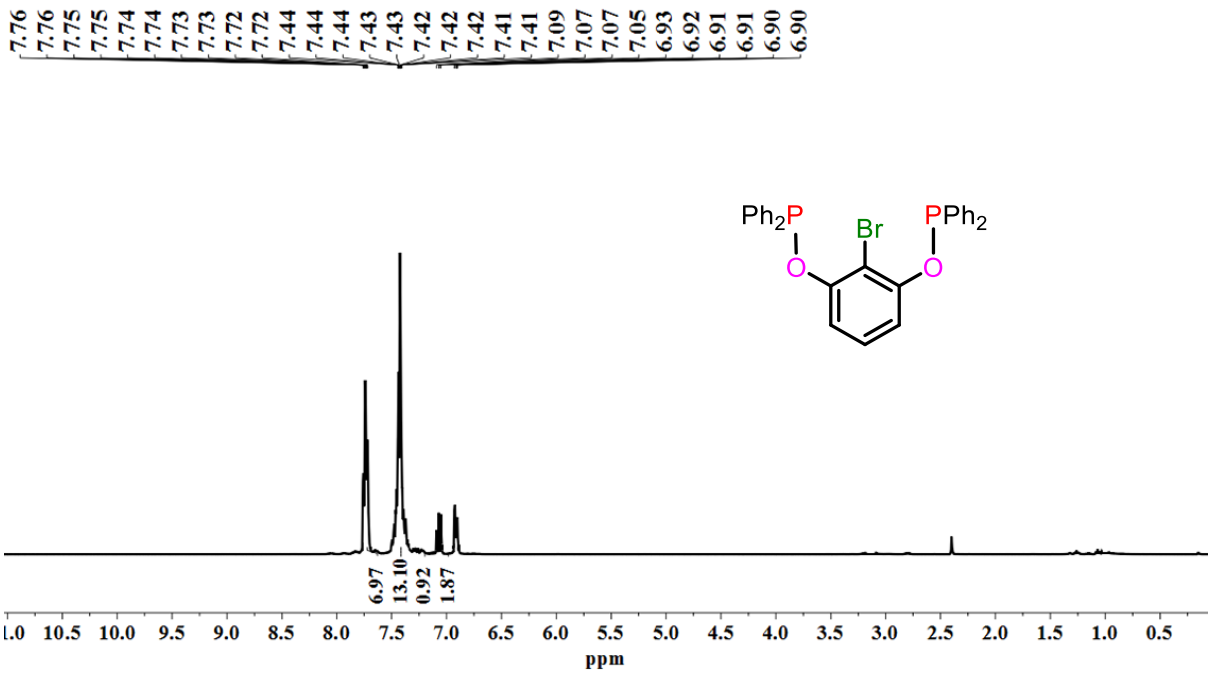

Fig. S12 ^{1}H NMR spectrum of **11** in $CDCl_3$ (400 MHz).

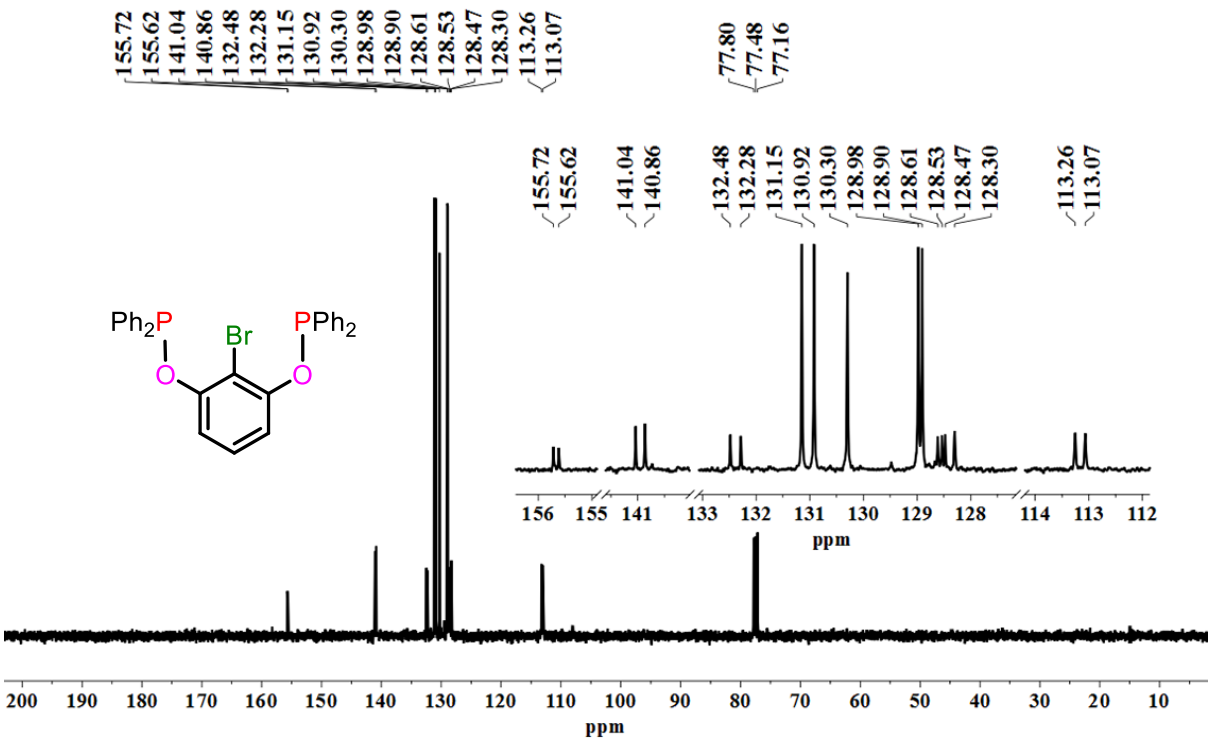

Fig. S13 $^{13}C\{^{1}H\}$ NMR spectrum of **11** in $CDCl_3$ (101 MHz).

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Analysis Info

Analysis Name	D:\Data\JULY-19\MSB-DM-O-PPh2.d	Acquisition Date	7/19/2019 7:10:13 PM
Method	Tune_pos_NAICSI-1000a.m	Operator	ppi in
Sample Name	MSB-DM-O-PPh2	Instrument	maXis impact 282001.00081
Comment	C30H23BrO2P2		

Acquisition Parameter

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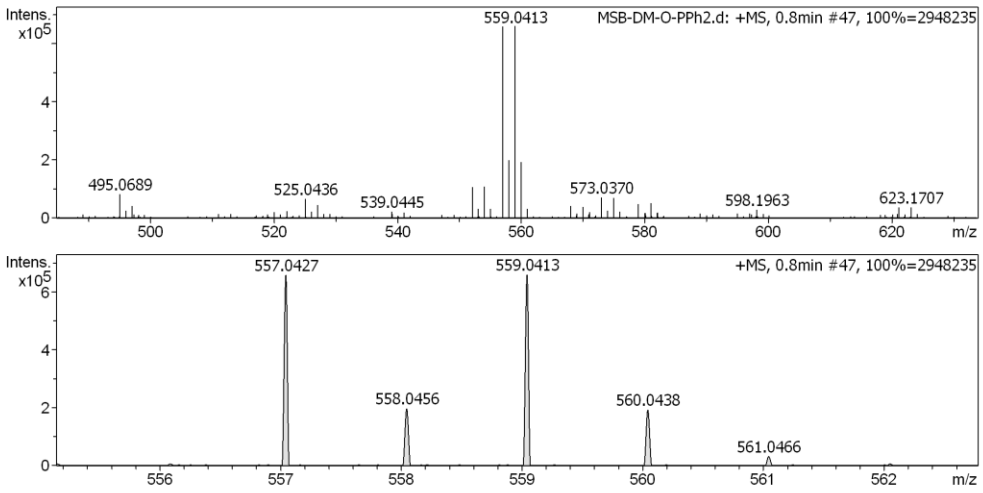
Scan End	1000 m/z	Set Collision Cell RF	1200.0 Vpp	Set Divert Valve	Source



Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule
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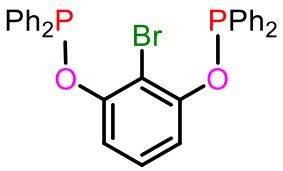
$[M+H]^+$ Calcd. 557.0429

Found 557.0427



Bruker Compass DataAnalysis 4.1 printed: 7/20/2019 9:46:46 AM by: ppi in Page 1 of 1

Fig. S14 Mass spectrum of compound **11**

Table S1 Bond lengths for complex **5**

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
Br1	Ni1	2.3146(8)	C27	C28	1.386(9)
Br2	Ni2	2.294(3)	C28	C29	1.393(9)
Br2A	Ni2	2.369(3)	C29	C30	1.372(8)
Ni1	P1	2.1471(15)	C31	C32	1.552(6)
Ni1	P2	2.1553(14)	C31	C36	1.523(6)
Ni1	C18	1.892(4)	C32	C33	1.512(8)
Ni2	P3	2.1495(18)	C33	C34	1.516(16)
Ni2	P4	2.1444(18)	C33	C34A	1.527(16)
Ni2	C38	1.881(5)	C34	C35	1.46(3)
P1	O1	1.643(4)	C34A	C35A	1.45(3)
P1	C1	1.810(6)	C36	C37	1.386(7)
P1	C7	1.806(5)	C36	C41	1.390(7)
P1	C7A	1.820(7)	C37	C38	1.402(7)
P2	O2	1.632(3)	C38	C39	1.373(7)
P2	C19	1.806(5)	C39	C40	1.400(7)
P2	C25	1.800(5)	C40	C41	1.399(6)
P3	O3	1.637(4)	C40	C42	1.530(7)
P3	C47	1.923(5)	C42	$C14^{1}$	1.508(6)
P3	C47A	1.653(7)	C42	C43	1.544(6)
P3	C53	1.806(5)	C43	C44	1.527(7)
P4	O4	1.635(4)	C44	C45	1.533(7)
P4	C65	1.815(5)	C45	C46	1.531(8)
P4	C0AA	1.849(8)	C47	C48	1.3900

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
P4	C0AB	1.763(10)	C47	C52	1.3900
O1	C13	1.398(5)	C48	C49	1.3900
O2	C17	1.392(6)	C49	C50	1.3900
O3	C37	1.405(6)	C50	C51	1.3900
O4	C39	1.410(5)	C51	C52	1.3900
C1	C2	1.374(9)	C47A	C48A	1.3900
C1	C6	1.378(8)	C47A	C52A	1.3900
C2	C3	1.376(11)	C48A	C49A	1.3900
C3	C4	1.406(11)	C49A	C50A	1.3900
C4	C5	1.330(11)	C50A	C51A	1.3900
C5	C6	1.393(10)	C51A	C52A	1.3900
C7	C8	1.3900	C53	C54	1.389(8)
C7	C12	1.3900	C53	C58	1.396(8)
C8	C9	1.3900	C54	C55	1.398(8)
C9	C10	1.3900	C55	C56	1.381(9)
C10	C11	1.3900	C56	C57	1.369(10)
C11	C12	1.3900	C57	C58	1.391(8)
C7A	C8A	1.3900	C65	C66	1.387(8)
C7A	C12A	1.3900	C65	C70	1.360(8)
C8A	C9A	1.3900	C66	C67	1.374(9)
C9A	C10A	1.3900	C67	C68	1.351(9)
C10A	C11A	1.3900	C68	C69	1.391(9)
C11A	C12A	1.3900	C69	C70	1.393(9)
C13	C14	1.375(6)	C1AA	C0AA	1.415(11)

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
C13	C18	1.405(7)	C1AA	C2AA	1.385(11)
C14	C15	1.413(7)	C0AA	C5AA	1.380(12)
C14	C42[1]	1.508(6)	C2AA	C3AA	1.332(13)
C15	C16	1.391(7)	C3AA	C4AA	1.393(12)
C16	C17	1.395(6)	C5AA	C4AA	1.393(12)
C16	C31	1.521(6)	C0AB	C1AB	1.395(15)
C17	C18	1.381(6)	C0AB	C5AB	1.383(16)
C19	C20	1.383(7)	C1AB	C2AB	1.381(16)
C19	C24	1.376(8)	C2AB	C3AB	1.335(18)
C20	C21	1.387(9)	C3AB	C4AB	1.388(18)
C21	C22	1.332(10)	C4AB	C5AB	1.389(17)
C22	C23	1.369(10)	Cl1	C6AA	1.668(17)
C23	C24	1.409(8)	Cl2	C6AA	1.882(17)
C25	C26	1.389(7)	Cl2A	C6AB	1.843(19)
C25	C30	1.401(7)	C6AB	Cl1A	1.56(2)
C26	C27	1.378(9)			

Table S2 Bond angles for complex **5.**

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
P1	Ni1	Br1	99.66(4)	C24	C19	C20	120.6(5)
P1	Ni1	P2	162.63(6)	C19	C20	C21	119.6(6)
P2	Ni1	Br1	96.97(4)	C22	C21	C20	120.3(6)
C18	Ni1	Br1	178.13(14)	C21	C22	C23	121.2(6)
C18	Ni1	P1	81.89(15)	C22	C23	C24	120.2(7)

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C18	Ni1	P2	81.58(14)	C19	C24	C23	118.0(6)
P3	Ni2	Br2	101.74(10)	C26	C25	P2	120.4(4)
P3	Ni2	Br2A	92.09(8)	C26	C25	C30	120.2(5)
P4	Ni2	Br2	94.09(9)	C30	C25	P2	119.4(4)
P4	Ni2	Br2A	103.14(8)	C27	C26	C25	118.8(5)
P4	Ni2	P3	164.17(6)	C26	C27	C28	121.5(6)
C38	Ni2	Br2	166.9(2)	C27	C28	C29	119.4(6)
C38	Ni2	Br2A	173.51(19)	C30	C29	C28	120.0(6)
C38	Ni2	P3	82.79(16)	C29	C30	C25	120.1(5)
C38	Ni2	P4	81.70(16)	C16	C31	C32	114.2(4)
O1	P1	Ni1	107.19(13)	C16	C31	C36	110.3(4)
O1	P1	C1	101.5(2)	C36	C31	C32	110.4(4)
O1	P1	C7	105.1(3)	C33	C32	C31	113.7(4)
O1	P1	C7A	98.6(4)	C32	C33	C34	118.6(15)
C1	P1	Ni1	121.33(18)	C32	C33	C34A	113.3(16)
C1	P1	C7A	110.4(4)	C35	C34	C33	120(2)
C7	P1	Ni1	117.9(3)	C35A	C34A	C33	136(3)
C7	P1	C1	101.6(3)	C37	C36	C31	121.4(4)
C7A	P1	Ni1	114.3(4)	C37	C36	C41	117.3(4)
O2	P2	Ni1	106.13(13)	C41	C36	C31	121.3(4)
O2	P2	C19	103.0(2)	C36	C37	O3	119.6(4)
O2	P2	C25	100.7(2)	C36	C37	C38	123.1(5)
C19	P2	Ni1	113.03(18)	C38	C37	O3	117.3(4)
C25	P2	Ni1	124.23(17)	C37	C38	Ni2	121.3(4)

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C25	P2	C19	107.1(2)	C39	C38	Ni2	122.1(4)
O3	P3	Ni2	106.45(15)	C39	C38	C37	116.3(5)
O3	P3	C47	101.0(3)	C38	C39	O4	117.9(4)
O3	P3	C47A	110.8(4)	C38	C39	C40	124.3(4)
O3	P3	C53	102.0(2)	C40	C39	O4	117.7(4)
C47	P3	Ni2	122.08(19)	C39	C40	C42	121.3(4)
C47A	P3	Ni2	110.2(3)	C41	C40	C39	116.0(4)
C47A	P3	C53	108.5(4)	C41	C40	C42	122.5(4)
C53	P3	Ni2	118.58(19)	C36	C41	C40	122.9(4)
C53	P3	C47	103.6(3)	C14[1]	C42	C40	113.7(4)
O4	P4	Ni2	107.03(13)	C14[1]	C42	C43	113.0(4)
O4	P4	C65	104.2(2)	C40	C42	C43	108.2(4)
O4	P4	C0AA	96.0(3)	C44	C43	C42	114.9(4)
O4	P4	C0AB	112.0(5)	C43	C44	C45	113.1(4)
C65	P4	Ni2	115.38(19)	C46	C45	C44	112.6(5)
C65	P4	C0AA	102.8(3)	C48	C47	P3	116.7(3)
C0AA	P4	Ni2	127.7(3)	C48	C47	C52	120.0
C0AB	P4	Ni2	111.6(5)	C52	C47	P3	123.2(3)
C0AB	P4	C65	106.5(4)	C49	C48	C47	120.0
C13	O1	P1	111.6(3)	C48	C49	C50	120.0
C17	O2	P2	110.6(3)	C51	C50	C49	120.0
C37	O3	P3	111.6(3)	C52	C51	C50	120.0
C39	O4	P4	110.3(3)	C51	C52	C47	120.0
C2	C1	P1	119.8(4)	C48A	C47A	P3	119.6(6)

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C2	C1	C6	119.0(6)	C48A	C47A	C52A	120.0
C6	C1	P1	121.1(5)	C52A	C47A	P3	120.1(6)
C1	C2	C3	120.9(7)	C47A	C48A	C49A	120.0
C2	C3	C4	118.7(8)	C50A	C49A	C48A	120.0
C5	C4	C3	120.8(7)	C49A	C50A	C51A	120.0
C4	C5	C6	120.2(7)	C52A	C51A	C50A	120.0
C1	C6	C5	120.4(7)	C51A	C52A	C47A	120.0
C8	C7	P1	120.6(4)	C54	C53	P3	120.2(4)
C8	C7	C12	120.0	C54	C53	C58	120.0(5)
C12	C7	P1	118.7(4)	C58	C53	P3	119.7(5)
C9	C8	C7	120.0	C53	C54	C55	120.2(6)
C8	C9	C10	120.0	C56	C55	C54	119.3(6)
C9	C10	C11	120.0	C57	C56	C55	120.6(6)
C12	C11	C10	120.0	C56	C57	C58	121.1(6)
C11	C12	C7	120.0	C57	C58	C53	118.8(6)
C8A	C7A	P1	117.2(6)	C66	C65	P4	120.2(4)
C8A	C7A	C12A	120.0	C70	C65	P4	120.3(4)
C12A	C7A	P1	122.7(6)	C70	C65	C66	119.4(5)
C9A	C8A	C7A	120.0	C67	C66	C65	120.4(6)
C8A	C9A	C10A	120.0	C68	C67	C66	120.9(6)
C9A	C10A	C11A	120.0	C67	C68	C69	119.3(6)
C10A	C11A	C12A	120.0	C68	C69	C70	120.1(6)
C11A	C12A	C7A	120.0	C65	C70	C69	119.9(6)
O1	C13	C18	116.9(4)	C2AA	C1AA	C0AA	120.8(9)

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C14	C13	O1	119.6(4)	C1AA	C0AA	P4	116.5(7)
C14	C13	C18	123.5(4)	C5AA	C0AA	P4	124.8(6)
C13	C14	C15	116.7(4)	C5AA	C0AA	C1AA	118.5(7)
C13	C14	C42[1]	121.1(4)	C3AA	C2AA	C1AA	120.1(8)
C15	C14	C42[1]	122.1(4)	C2AA	C3AA	C4AA	120.6(8)
C16	C15	C14	122.9(4)	C0AA	C5AA	C4AA	119.1(8)
C15	C16	C17	116.4(4)	C3AA	C4AA	C5AA	120.7(9)
C15	C16	C31	125.4(4)	C1AB	C0AB	P4	124.2(10)
C17	C16	C31	118.2(4)	C5AB	C0AB	P4	113.6(9)
O2	C17	C16	118.0(4)	C5AB	C0AB	C1AB	121.9(11)
C18	C17	O2	117.9(4)	C2AB	C1AB	C0AB	117.5(14)
C18	C17	C16	124.0(4)	C3AB	C2AB	C1AB	121.4(14)
C13	C18	Ni1	122.0(3)	C2AB	C3AB	C4AB	121.2(16)
C17	C18	Ni1	121.3(3)	C3AB	C4AB	C5AB	119.6(16)
C17	C18	C13	116.4(4)	C0AB	C5AB	C4AB	118.0(13)
C20	C19	P2	120.0(4)	Cl1	C6AA	Cl2	116.3(10)
C24	C19	P2	119.0(4)	Cl1A	C6AB	Cl2A	132.2(14)

Table S3 Bond lengths for complex **6**

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
Pd1	Br1	2.463(2)	C19A	C24A	1.3900
Pd1	P1	2.277(4)	C20A	C21A	1.3900
Pd1	P2	2.288(4)	C21A	C22A	1.3900
Pd1	C13	2.009(11)	C22A	C23A	1.3900

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
Pd2	Br2	2.4845(12)	C23A	C24A	1.3900
Pd2	P3	2.266(3)	C25	C26	1.3900
Pd2	P4	2.266(3)	C25	C30	1.3900
Pd2	C36	2.015(8)	C26	C27	1.3900
P1	O1	1.640(8)	C27	C28	1.3900
P1	C1	1.868(9)	C28	C29	1.3900
P1	C1A	1.722(9)	C29	C30	1.3900
P1	C7	1.854(10)	C25A	C26A	1.3900
P1	C7A	1.778(10)	C25A	C30A	1.3900
P2	O2	1.648(8)	C26A	C27A	1.3900
P2	C19	1.765(11)	C27A	C28A	1.3900
P2	C19A	1.805(11)	C28A	C29A	1.3900
P2	C25	1.785(14)	C29A	C30A	1.3900
P2	C25A	1.863(14)	C31	C32	1.554(13)
P3	O3	1.642(6)	C31	C38	1.516(14)
P3	C42	1.762(13)	C32	C33	1.521(14)
P3	C48	1.774(12)	C33	C34	1.513(15)
P3	C48A	1.776(12)	C34	C35	1.510(15)
P4	O4	1.634(6)	C36	C37	1.372(13)
P4	C59	1.774(12)	C36	C41	1.386(12)
P4	C65	1.816(10)	C37	C38	1.398(12)
O1	C14	1.401(10)	C38	C39	1.399(13)
O2	C18	1.400(13)	C39	C40	1.360(13)
O3	C37	1.408(11)	C40	C41	1.397(11)

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
O4	C41	1.403(11)	C40	C54	1.512(13)
C1	C2	1.3900	C42	C43	1.361(19)
C1	C6	1.3900	C42	C47	1.398(18)
C2	C3	1.3900	C43	C44	1.40(2)
C3	C4	1.3900	C44	C45	1.36(2)
C4	C5	1.3900	C45	C46	1.34(2)
C5	C6	1.3900	C46	C47	1.39(2)
C1A	C2A	1.3900	C48	C49	1.3900
C1A	C6A	1.3900	C48	C53	1.3900
C2A	C3A	1.3900	C49	C50	1.3900
C3A	C4A	1.3900	C50	C51	1.3900
C4A	C5A	1.3900	C51	C52	1.3900
C5A	C6A	1.3900	C52	C53	1.3900
C7	C8	1.3900	C48A	C49A	1.3900
C7	C12	1.3900	C48A	C53A	1.3900
C8	C9	1.3900	C49A	C50A	1.3900
C9	C10	1.3900	C50A	C51A	1.3900
C10	C11	1.3900	C51A	C52A	1.3900
C11	C12	1.3900	C52A	C53A	1.3900
C7A	C8A	1.3900	C54	$C15^{1}$	1.507(15)
C7A	C12A	1.3900	C54	C55	1.523(12)
C8A	C9A	1.3900	C55	C56	1.533(16)
C9A	C10A	1.3900	C55	C56A	1.533(16)
C10A	C11A	1.3900	C56	C57	1.50(2)

Atom	Atom	Length(Å)	Atom	Atom	Length(Å)
C11A	C12A	1.3900	C57	C58	1.51(3)
C13	C14	1.368(15)	C56A	C57A	1.51(2)
C13	C18	1.369(13)	C57A	C58A	1.50(3)
C14	C15	1.372(14)	C59	C60	1.370(16)
C15	C16	1.418(12)	C59	C64	1.403(13)
C15	C54[1]	1.507(15)	C60	C61	1.39(2)
C16	C17	1.372(13)	C61	C62	1.381(18)
C17	C18	1.373(14)	C62	C63	1.330(19)
C17	C31	1.533(12)	C63	C64	1.367(17)
C19	C20	1.3900	C65	C66	1.387(14)
C19	C24	1.3900	C65	C70	1.351(15)
C20	C21	1.3900	C66	C67	1.405(16)
C21	C22	1.3900	C67	C68	1.367(18)
C22	C23	1.3900	C68	C69	1.322(17)
C23	C24	1.3900	C69	C70	1.383(16)
C19A	C20A	1.3900			

Table S4 Bond angles for complex **6**

Atom	Atom	Atom	Angle(˚)	Atom	Atom	Atom	Angle(˚)
P1	Pd1	Br1	98.54(12)	C20	C19	C24	120.0
P1	Pd1	P2	159.86(13)	C24	C19	P2	119.9(13)
P2	Pd1	Br1	101.40(13)	C19	C20	C21	120.0
C13	Pd1	Br1	176.2(3)	C22	C21	C20	120.0
C13	Pd1	P1	79.9(3)	C21	C22	C23	120.0

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C13	Pd1	P2	80.4(3)	C24	C23	C22	120.0
P3	Pd2	Br2	103.54(7)	C23	C24	C19	120.0
P4	Pd2	Br2	97.13(7)	C20A	C19A	P2	116.6(13)
P4	Pd2	P3	158.55(9)	C20A	C19A	C24A	120.0
C36	Pd2	Br2	177.0(3)	C24A	C19A	P2	123.3(13)
C36	Pd2	P3	79.5(3)	C19A	C20A	C21A	120.0
C36	Pd2	P4	79.9(3)	C22A	C21A	C20A	120.0
O1	P1	Pd1	105.1(3)	C21A	C22A	C23A	120.0
O1	P1	C1	95.4(5)	C24A	C23A	C22A	120.0
O1	P1	C1A	112.6(6)	C23A	C24A	C19A	120.0
O1	P1	C7	97.2(6)	C26	C25	P2	118.2(15)
O1	P1	C7A	112.0(6)	C26	C25	C30	120.0
C1	P1	Pd1	127.1(5)	C30	C25	P2	121.5(15)
C1A	P1	Pd1	111.2(5)	C27	C26	C25	120.0
C1A	P1	C7A	107.0(7)	C26	C27	C28	120.0
C7	P1	Pd1	126.2(5)	C29	C28	C27	120.0
C7	P1	C1	97.8(7)	C28	C29	C30	120.0
C7A	P1	Pd1	109.0(5)	C29	C30	C25	120.0
O2	P2	Pd1	103.5(4)	C26A	C25A	P2	111.6(14)
O2	P2	C19	101.4(8)	C26A	C25A	C30A	120.0
O2	P2	C19A	105.5(8)	C30A	C25A	P2	127.3(14)
O2	P2	C25	95.9(8)	C27A	C26A	C25A	120.0
O2	P2	C25A	108.2(8)	C26A	C27A	C28A	120.0
C19	P2	Pd1	105.0(7)	C29A	C28A	C27A	120.0

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C19	P2	C25	124.0(10)	C28A	C29A	C30A	120.0
C19A	P2	Pd1	117.5(7)	C29A	C30A	C25A	120.0
C19A	P2	C25A	91.8(10)	C17	C31	C32	108.6(7)
C25	P2	Pd1	122.0(7)	C38	C31	C17	113.1(8)
C25A	P2	Pd1	128.4(7)	C38	C31	C32	113.1(8)
O3	P3	Pd2	106.0(3)	C33	C32	C31	114.3(8)
O3	P3	C42	102.5(5)	C34	C33	C32	112.6(9)
O3	P3	C48	102.3(7)	C35	C34	C33	113.6(10)
O3	P3	C48A	104.9(8)	C37	C36	Pd2	121.7(6)
C42	P3	Pd2	119.1(4)	C37	C36	C41	118.2(8)
C42	P3	C48	106.2(8)	C41	C36	Pd2	120.0(7)
C42	P3	C48A	103.8(8)	C36	C37	O3	118.6(7)
C48	P3	Pd2	118.2(7)	C36	C37	C38	122.4(8)
C48A	P3	Pd2	118.6(8)	C38	C37	O3	118.8(8)
O4	P4	Pd2	105.1(2)	C37	C38	C31	120.1(8)
O4	P4	C59	101.0(4)	C37	C38	C39	115.5(9)
O4	P4	C65	103.0(4)	C39	C38	C31	124.3(8)
C59	P4	Pd2	125.2(3)	C40	C39	C38	125.2(8)
C59	P4	C65	107.2(5)	C39	C40	C41	115.7(8)
C65	P4	Pd2	112.5(4)	C39	C40	C54	126.2(7)
C14	O1	P1	114.0(7)	C41	C40	C54	118.0(8)
C18	O2	P2	115.7(7)	C36	C41	O4	119.1(7)
C37	O3	P3	113.8(6)	C36	C41	C40	122.8(9)
C41	O4	P4	112.9(5)	C40	C41	O4	118.0(8)

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C2	C1	P1	126.9(7)	C43	C42	P3	122.8(10)
C2	C1	C6	120.0	C43	C42	C47	115.8(14)
C6	C1	P1	113.0(7)	C47	C42	P3	121.4(11)
C3	C2	C1	120.0	C42	C43	C44	123.2(16)
C2	C3	C4	120.0	C45	C44	C43	118.5(18)
C5	C4	C3	120.0	C46	C45	C44	120.6(17)
C4	C5	C6	120.0	C45	C46	C47	120.4(19)
C5	C6	C1	120.0	C46	C47	C42	121.2(17)
C2A	C1A	P1	113.7(8)	C49	C48	P3	121.1(13)
C2A	C1A	C6A	120.0	C49	C48	C53	120.0
C6A	C1A	P1	125.8(8)	C53	C48	P3	118.9(13)
C3A	C2A	C1A	120.0	C50	C49	C48	120.0
C4A	C3A	C2A	120.0	C51	C50	C49	120.0
C3A	C4A	C5A	120.0	C50	C51	C52	120.0
C4A	C5A	C6A	120.0	C53	C52	C51	120.0
C5A	C6A	C1A	120.0	C52	C53	C48	120.0
C8	C7	P1	127.4(8)	C49A	C48A	P3	123.4(13)
C8	C7	C12	120.0	C49A	C48A	C53A	120.0
C12	C7	P1	112.3(8)	C53A	C48A	P3	115.9(13)
C7	C8	C9	120.0	C48A	C49A	C50A	120.0
C10	C9	C8	120.0	C51A	C50A	C49A	120.0
C11	C10	C9	120.0	C50A	C51A	C52A	120.0
C10	C11	C12	120.0	C51A	C52A	C53A	120.0
C11	C12	C7	120.0	C52A	C53A	C48A	120.0

Atom	Atom	Atom	Angle(°)	Atom	Atom	Atom	Angle(°)
C8A	C7A	P1	115.5(8)	C15[1]	C54	C40	110.9(7)
C8A	C7A	C12A	120.0	C15[1]	C54	C55	111.4(8)
C12A	C7A	P1	124.2(8)	C40	C54	C55	115.6(9)
C9A	C8A	C7A	120.0	C54	C55	C56	115.6(9)
C8A	C9A	C10A	120.0	C54	C55	C56A	115.6(9)
C11A	C10A	C9A	120.0	C57	C56	C55	115.1(12)
C10A	C11A	C12A	120.0	C56	C57	C58	110.3(17)
C11A	C12A	C7A	120.0	C57A	C56A	C55	114.3(16)
C14	C13	Pd1	121.2(7)	C58A	C57A	C56A	111(2)
C14	C13	C18	117.3(10)	C60	C59	P4	122.3(9)
C18	C13	Pd1	121.1(9)	C60	C59	C64	117.4(11)
C13	C14	O1	119.0(9)	C64	C59	P4	119.9(8)
C13	C14	C15	123.1(9)	C59	C60	C61	120.9(13)
C15	C14	O1	117.8(10)	C62	C61	C60	118.9(14)
C14	C15	C16	116.0(10)	C63	C62	C61	121.6(15)
C14	C15	C54[1]	124.0(8)	C62	C63	C64	119.6(13)
C16	C15	C54[1]	120.0(9)	C63	C64	C59	121.5(11)
C17	C16	C15	123.4(9)	C66	C65	P4	118.7(8)
C16	C17	C18	115.7(8)	C70	C65	P4	121.1(8)
C16	C17	C31	124.7(9)	C70	C65	C66	119.8(10)
C18	C17	C31	119.3(10)	C65	C66	C67	118.6(12)
C13	C18	O2	118.4(10)	C68	C67	C66	119.0(13)
C13	C18	C17	124.4(11)	C69	C68	C67	122.0(13)
C17	C18	O2	117.0(9)	C68	C69	C70	119.7(13)

Atom	Atom	Atom	Angle(˚)	Atom	Atom	Atom	Angle(˚)
C20	C19	P2	119.4(13)	C65	C70	C69	120.8(12)