Supplementary Material A: Predictions of Unknown Compositions

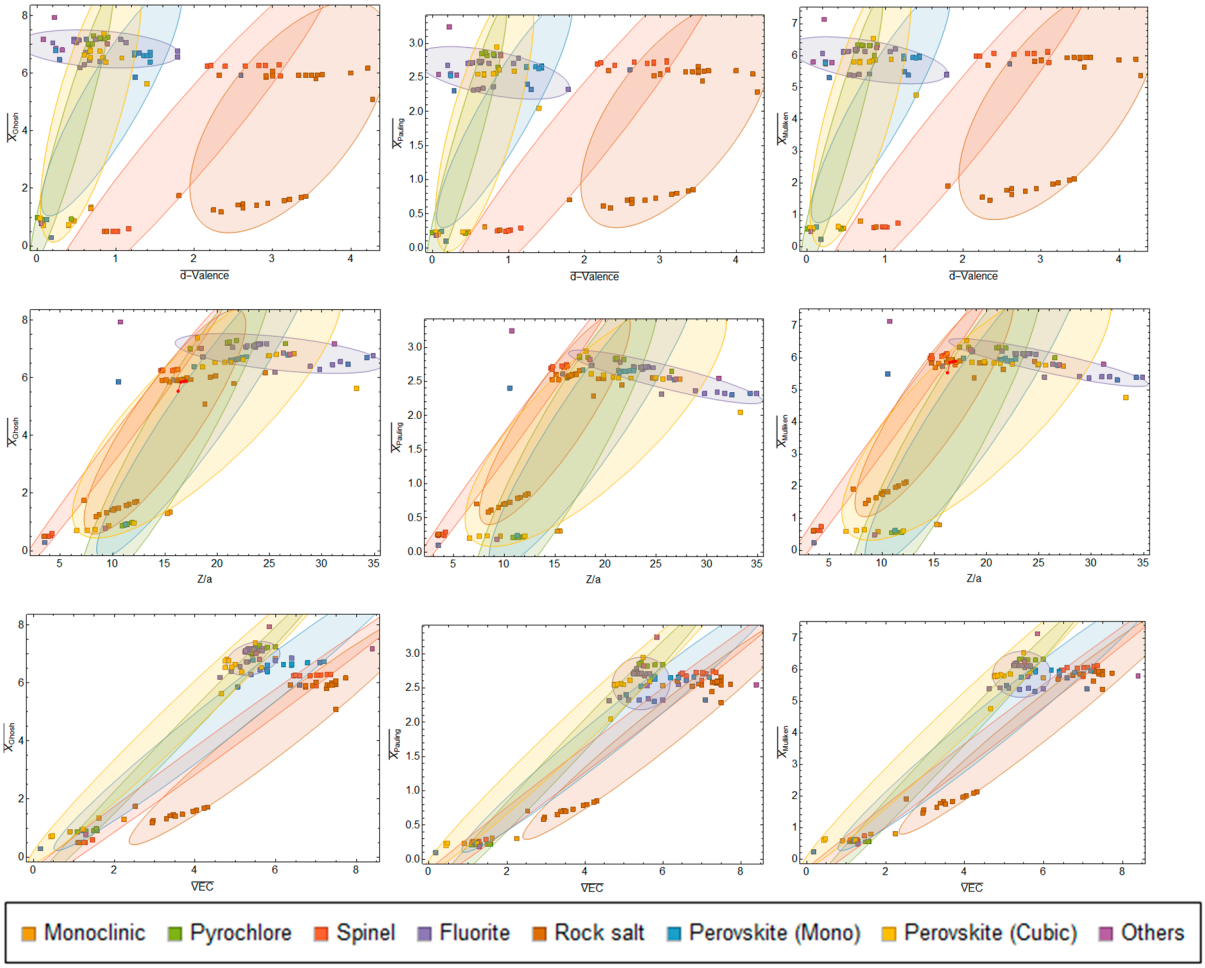

Figure S1. Biplots and encapsulating regions for 3^2 biplots of rules-of-mixtures Ghosh, Pauling, and Mulliken electronegativities plotted against rules-of-mixtures semi-empirical parameters number of valence *d* electrons (*d*-valence), atomic number *per* atom ratio (*Z/a)*, and valence electron concentration (*VEC)*.

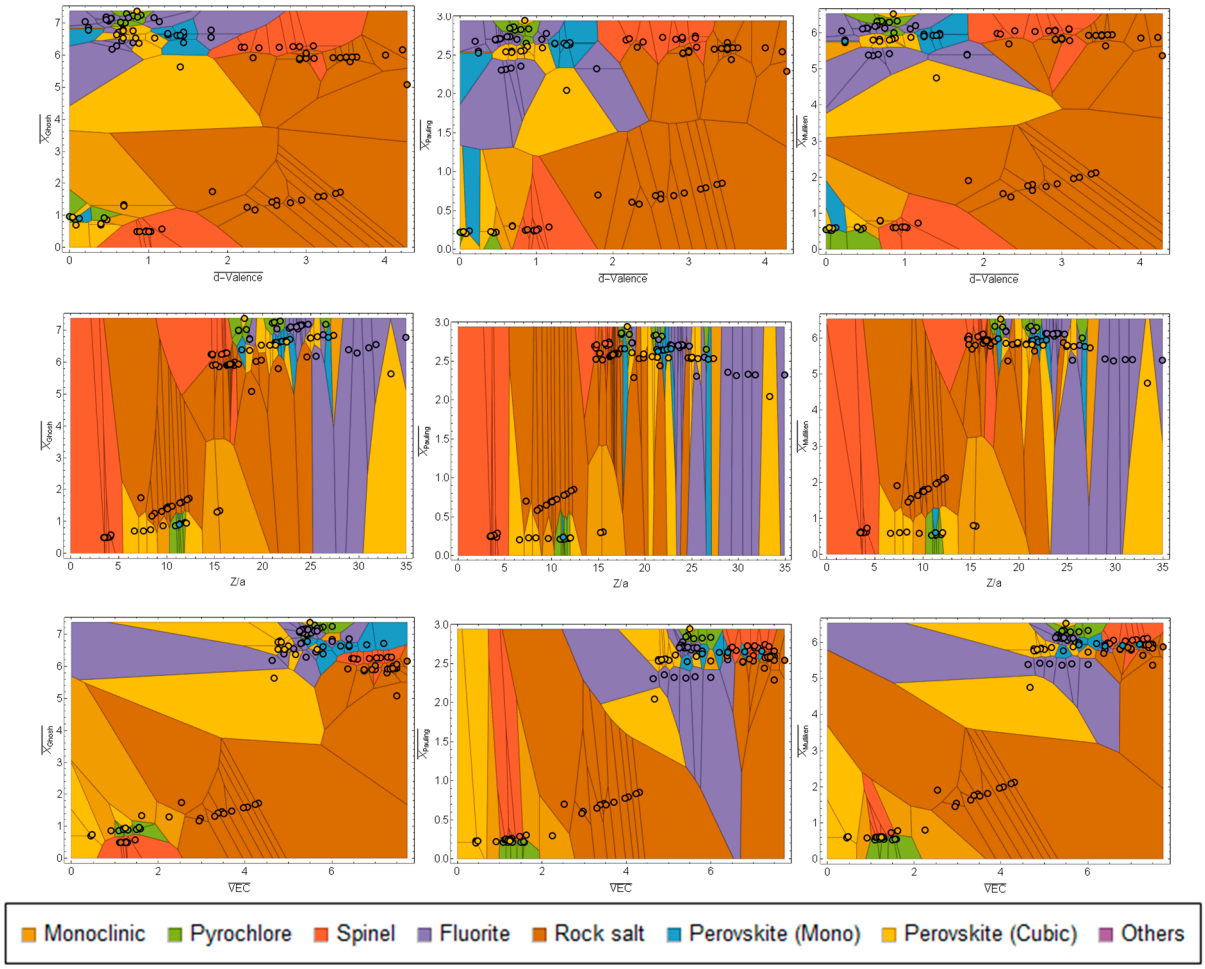

Figure S2. Biplots and Voronoi Tesselations for 3^2 biplots of rules-of-mixtures Ghosh, Pauling, and Mulliken electronegativities plotted against rules-of-mixtures semi-empirical parameters number of valence *d* electrons (*d*-valence), atomic number *per* atom ratio (*Z/a)*, and valence electron concentration (*VEC)*.

Supplementary Material B: Predictions of Unknown Compositions

For any known composition of *e.g.* $((AB)_x(CD)_{1-x})O_2$ the stable phase may be predicted against the biplots shown in the manuscript by determine the atomic-number-per-atom (*Z/a*) and Ghosh electronegativity ratios using the rule-of-mixtures. The rule-of-mixtures are the molar weighted averages of either values. An example is given for modifications to the composition $((NiCoMgCuZn)(Ti_x)O_n$ which is reported in the literature to show the spinel structure occurring for the x = 1 and the rock salt structure when x = 0 (*cf*. dataset below). When x = 0, n = 1, and when x = 1, n = 4. Values of n for x = 0.2, 0.4, 0.6, and 0.8 are obtained through interpolation and thus are 1.37, 1.83, 2.4, and 3.11. The specific molar ratios are shown in Table B1 below.

Table S1. Molar ratios of $((NiCoMgCuZn)(Ti_x)O_n$ values (x: 0, 0.2, 0.4, 0.6, 0.8, and 1.0)

x	Ni	Co	Mg	Cu	Zn	Ti	O
0.00	0.10	0.10	0.10	0.10	0.10	0.00	0.50
0.20	0.08	0.08	0.08	0.08	0.08	0.08	0.53
0.40	0.06	0.06	0.06	0.06	0.06	0.12	0.57
0.60	0.05	0.05	0.05	0.05	0.05	0.15	0.60
0.80	0.04	0.04	0.04	0.04	0.04	0.16	0.63
1.00	0.03	0.03	0.03	0.03	0.03	0.17	0.67

The rules-of-mixtures *Z/a* and X_{Ghosh} values can thus be calculated and are shown in Table B2 below.

Table S2. Rules-of-mixtures calculations of $((NiCoMgCuZn)(Ti_x)O_n$ values (x: 0, 0.2, 0.4, 0.6, 0.8, and 1.0) for atomic number per atom (*Z/a*) and Ghosh electronegativity (X_{Ghosh})

x	ROM *Z/a*	ROM X_{Ghosh}	Literature	Prediction
0	14.32	5.97	Rock Salt	Rock Salt
0.2	13.3	6.1		Spinel
0.4	12.5	6.2		Spinel
0.6	11.7	6.4		Spinel
0.8	10.9	6.5		Spinel
1.0	10.1	6.7	Spinel	Spinel

The values can be calculations are shown graphically in Figure B1 where the predictions suggest that minor additions of Ti will destabilise the system

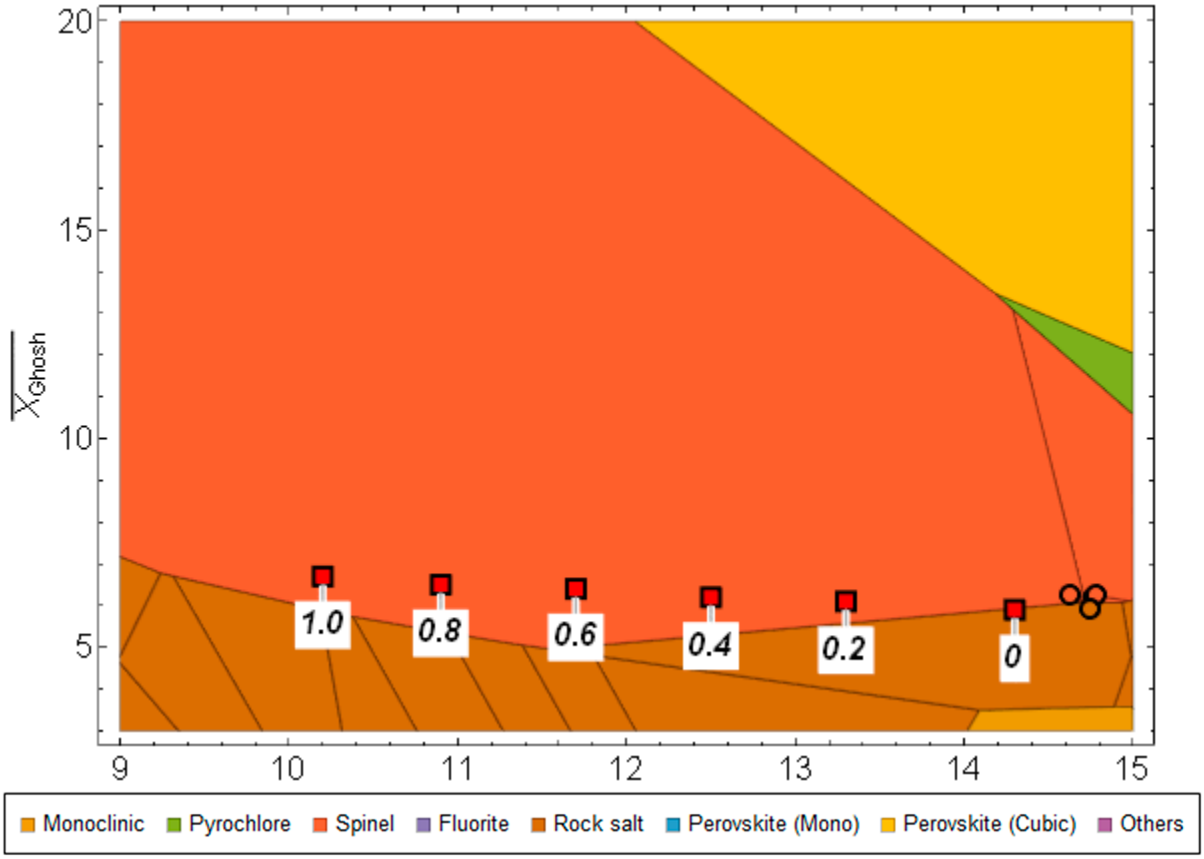

Figure S3. Overlay of Z/a-X_{Ghosh} biplot with phase stable regions obtained through Voronoi tessellation shown. $((NiCoMgCuZn)(Ti_x)O_n$ values (x: 0, 0.2, 0.4, 0.6, 0.8, and 1.0) are overplotted in the figure.

Supplementary Material c: List of Compositions used for analysis

Table S3 List of Compositions used for analysis

No	Name	Phase names	Phase 1	Phase 2	Phase 3	Category	Reference (DOI)
1	(NiFeCoCrAl)O	Spinel, BCC, and FCC	Fd-3m	Fm-3m	Im3m	Mixed	10.1021/acsami.9b08794
2	$(Sm_{0.2}Eu_{0.2}Tb_{0.2}Dy_{0.2}Lu_{0.2})_2Zr_2O_7$	Pyrochlore	Fd-3m	Fm-3m		Mixed	10.1016/j.scriptamat.2019.12.006
3	$Li(NiCoMnAl)_1O_2$	Spinel	Fd-3m	Fm-3m		Mixed	10.1038/s41598-020-75134-1
4	$(La_{0.2}Nd_{0.2}Sm_{0.2}Gd_{0.2}Yb_{0.2})_2Zr_2O_7$	Pyrochlore	Fd-3m	Fm-3m		Mixed	10.1016/j.jallcom.2019.153328
5	(MgZnMnCoNi)O	Rock salt	Fm-3m	Fd-3m		Mixed	10.1021/acscombsci.0c00159
6	(MgNiZnCuCo)O	Rock salt	Fm-3m	Fd-3m		Mixed	10.1021/acs.jpclett.0c00602 10.1016/j.matchemphys.2020.124014
7	(CeGdLaNdPrSmY)O	Fluorite	Fm-3m	Ia-3		Mixed	10.1080/21663831.2016.1220433 10.1039/c7dt02077e
8	(CeZrYbHoEr)O	Fluorite	Fm-3m	Ia-3		Mixed	10.1016/j.actamat.2020.10.061
9	$TiHfZrNbTaO_{11}$	Monoclinic	$P2_1/n$	Pbnm		Mixed	10.1039/c9ta12846h
10	$Hf_{0.314}Zr_{0.314}Ce_{0.314}Y_{0.029}Yb_{0.029}O_2$	Tetragonal, Fluorite	$P4_2/nmc$	Fm-3m		Mixed	10.1016/j.jeurceramsoc.2020.01.015 10.1111/jace.17448
11	$Hf_{0.284}Zr_{0.284}Ce_{0.284}Y_{0.074}Yb_{0.074}O_2$	Tetragonal, Fluorite	$P4_2/nmc$	Fm-3m		Mixed	10.1016/j.jeurceramsoc.2020.01.015 10.1111/jace.17448
12	$(Ca_{0.25}Sr_{0.25}Ba_{0.25}Pb_{0.25})Bi_2Nb_2O_9$	Aurivillius	$A2_1am$			Single	10.1016/j.matdes.2020.109447
13	$(Yb_{0.25}Y_{0.25}Lu_{0.25}Er_{0.25})_2SiO_5$	Monoclinic	$C12/m1$			Single	10.1016/j.jmst.2019.07.022
14	$(Yb_{0.2}Y_{0.2}Lu_{0.2}Sc_{0.2}Gd_{0.2})_2Si_2O_7$	Monoclinic	$C12/m1$			Single	10.1016/j.jeurceramsoc.2019.02.022
15	$(Y_{0.25}Ho_{0.25}Er_{0.25}Yb_{0.25})_2SiO_5$	Monoclinic	C2/c			Single	10.1016/j.scriptamat.2019.04.018
16	$(GdLaNdSmY)_2O_3$	Monoclinic	C2/m			Single	10.1111/jace.16971
17	$Nd_2(Ta_{0.2}Sc_{0.2}Sn_{0.2}Hf_{0.2}Zr_{0.2})_2O_7$	Pyrochlore	Fd-3m			Single	10.1021/jacs.0c10739
18	$(La_{0.2}Nd_{0.2}Sm_{0.2}Eu_{0.2}Gd_{0.2})_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1007/s40145-019-0342-4
19	$(Gd_{0.25}Eu_{0.25}Sm_{0.25}Nd_{0.25})_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jeurceramsoc.2019.12.008
20	$Sm_2(Sn_{0.25}Ti_{0.25}Hf_{0.25}Zr_{0.25})_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.scriptamat.2020.02.011
21	$(La_{0.2}Ce_{0.2}Nd_{0.2}Sm_{0.2}Eu_{0.2})_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	
22	$(La_{0.2}Ce_{0.2}Nd_{0.2}Sm_{0.2}Eu_{0.2})_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2019.05.054
23	$(La_{0.2}Nd_{0.2}Sm_{0.2}Eu_{0.2}Gd_{0.2})_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jeurceramsoc.2020.01.018
24	$(CoMgMnNiZn)(AlCoCrFeMn)_2O_4$	Spinel	Fd-3m			Single	10.1016/j.scriptamat.2020.07.002
25	$(Mg_{0.2}Co_{0.2}Ni_{0.2}Cu_{0.2}Zn_{0.2})Al_2O_4$	Spinel	Fd-3m			Single	10.1016/j.scriptamat.2020.04.027
26	$(Mg_{0.2}Ti_{0.2}Zn_{0.2}Cu_{0.2}Fe_{0.2})_3O_4$	Spinel	Fd-3m			Single	10.1039/d0ra00255k
27	$(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})_3O_4$	Spinel	Fd-3m			Single	10.1016/j.matlet.2017.12.148
28	$(FeCoNiCrMn)_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jallcom.2020.156158
29	$(Mg_{0.2}Fe_{0.2}Co_{0.2}Ni_{0.2}Cu_{0.2})Fe_2O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
30	$(Co_{0.2}Cu_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})_3O_4$	Spinel	Fd-3m			Single	10.1039/c9ta08740k
31	$(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jmmm.2019.165884
32	$(Al_{0.167}Co_{0.167}Cr_{0.167}Fe_{0.167}Mn_{0.167}Ni_{0.167})_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jmmm.2020.166594
33	$(Zn_{0.2}Fe_{0.2}Ni_{0.2}Mg_{0.2}Cd_{0.2})Fe_2O_4$	Spinel	Fd-3m			Single	10.1038/s41598-019-56586-6
34	(NiCoCrFeMn)O	Spinel	Fd-3m			Single	10.1021/acsami.0c11899

35	$(Hf_{0.25}Zr_{0.25}Ce_{0.25}Y_{0.25})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
36	$(Ce_{0.2}Zr_{0.2}Hf_{0.2}Sn_{0.2}Ti_{0.2})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.063
37	$(Ce_{0.2}La_{0.2}Pr_{0.2}Sm_{0.2}Y_{0.2})O_2$	Fluorite	Fm-3m			Single	10.1016/j.scriptamat.2019.02.039
38	$(Gd_{0.2}La_{0.2}Y_{0.2}Hf_{0.2}Zr_{0.2})O_2$	Fluorite	Fm-3m			Single	10.1039/c9ra04636d
39	$Gd_{0.2}La_{0.2}Ce_{0.2}Hf_{0.2}Zr_{0.2}O_2$	Fluorite	Fm-3m			Single	10.1016/j.jallcom.2020.156716
40	$Gd_{0.2}La_{0.2}Y_{0.2}Hf_{0.2}Zr_{0.2}O_2$	Fluorite	Fm-3m			Single	10.1016/j.jallcom.2020.156716
41	$(Sc_{0.2}Ce_{0.2}Pr_{0.2}Gd_{0.2}Ho_{0.2})_2O_3$	Fluorite	Fm-3m			Single	10.1088/1757-899X/597/1/012005
42	(CeZrYLaGd)O	Fluorite	Fm-3m			Single	10.3390/ma13030558
43	(CeZrHfTiLa)O	Fluorite	Fm-3m			Single	10.1038/s41467-020-17738-9
44	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1021/acsami.0c13161 10.1039/D0CC05860B
45	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1080/21663831.2018.1554605
46	$(Mg_{0.2}Co_{0.2}\ Ni_{0.2}Cu_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1039/c9ra05508h
47	$(MgCoNiZn)_{0.84}Cu_{0.16}O$	Rock salt	Fm-3m			Single	10.1016/j.matdes.2021.109534
48	$(MgCoNiZn)_{0.82}Cu_{0.18}O$	Rock salt	Fm-3m			Single	10.1016/j.matdes.2021.109534
49	$(MgCoNiZn)_{0.72}Cu_{0.28}O$	Rock salt	Fm-3m			Single	10.1016/j.matdes.2021.109534
50	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.98}Li_{0.02}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d 10.1021/acsami.0c03562
51	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.92}Li_{0.08}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d
52	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.9}Li_{0.10}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d
53	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.84}Li_{0.16}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d
54	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.8}Li_{0.20}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d
55	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.75}Li_{0.25}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d
56	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})_{0.67}Li_{0.33}O$	Rock salt	Fm-3m			Single	10.1039/c6ta03249d
57	$(Co_{0.2}Ni_{0.2}Cu_{0.2}Zn_{0.2}Li_{0.1}Ga_{0.1})O$	Rock salt	Fm-3m			Single	10.1063/1.5091787
58	CuCeO(NiMgCuZnCo)O	Rock salt	Fm-3m			Single	10.1016/j.apcatb.2020.119155
59	(CeNiMgCuZnCo)O	Rock salt	Fm-3m			Single	10.1016/j.apcatb.2020.119155
60	$Li_{0.94}(Co_{0.2}Cu_{0.2}Mg_{0.2}Ni_{0.2}Zn_{0.2})OF_{0.87}$	Rock salt	Fm-3m			Single	10.1039/c9ee00368a
61	$(MgCoCuNiZn)_{0.95}Li_{0.05}O_{0.975}$	Rock salt	Fm-3m			Single	10.1021/acs.jpcc.9b04992
62	$(Co_{0.2}Cu_{0.2}Mg_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1038/s41467-018-05774-5 10.1016/j.elecom.2019.02.001 10.1016/j.actamat.2020.09.034
63	$(Co_{0.2}Cu_{0.2}Mg_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1016/j.actamat.2020.09.034
64	$(Co_{0.2}Cu_{0.2}Mg_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1016/j.actamat.2020.09.034
65	(CoCuMgNaNiZn)O	Rock salt	Fm-3m			Single	10.1039/D0DT00958J
66	$Pt_{0.3}Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2}O$	Rock salt	Fm-3m			Single	10.1039/c8ta01772g
67	$(Mg_{0.2}Co_{0.2}\ Ni_{0.2}Cu_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1007/s10853-018-2168-9
68	$(Mg_{0.2}Co_{0.2}\ Ni_{0.2}Cu_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1021/acsmaterialslett.9b00064
69	$(CuNiFeCoMg)OAl_2O_3$	Rock salt	Fm-3m			Single	10.1021/acs.chemmater.9b01244
70	$(Mg_{0.167}Co_{0.167}Cu_{0.167}Ni_{0.167}Zn_{0.167}Sc_{0.167})O$	Rock salt	Fm-3m			Single	10.1063/1.4962135
71	$(Mg_{0.167}Co_{0.167}Cu_{0.167}Ni_{0.167}Zn_{0.167}Li_{0.167})O$	Rock salt	Fm-3m			Single	10.1063/1.4962135
72	$(Mg_{0.25}Co_{0}Cu_{0.25}Ni_{0.25}Zn_{0.25})O$	Rock salt	Fm-3m			Single	10.1038/s41598-017-13810-5
73	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1038/s41598-017-13810-5
74	$(Mg_{0.1825}Co_{27}Cu_{0.1825}Ni_{0.1825}Zn_{0.1825})O$	Rock salt	Fm-3m			Single	10.1038/s41598-017-13810-5

75	$(Mg_{0.1675}Co_{0.33}Cu_{0.1675}Ni_{0.1675}Zn_{0.1675})O$	Rock salt	Fm-3m			Single	10.1038/s41598-017-13810-5
76	$(Al_{0.31}Cr_{0.20}Fe_{0.14}Ni_{0.35})O$	Rock salt	Fm-3m			Single	10.1088/1674-1056/28/4/046201
77	$(Mg_{0.18}Co_{0.27}Ni_{0.18}Cu_{0.18}Zn_{0.18})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
78	$(Mg_{0.17}Co_{0.33}Ni_{0.17}Cu_{0.17}Zn_{0.17})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
79	$(Mg_{0.22}Co_{0.22}Ni_{0.22}Cu_{0.11}Zn_{0.22})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
80	$(Mg_{0.21}Co_{0.21}Ni_{0.21}Cu_{0.16}Zn_{0.21})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
81	$(Mg_{0.2}Co_{0.2}Ni_{0.2}Cu_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
82	$(Mg_{0.18}Co_{0.18}Ni_{0.18}Cu_{0.27}Zn_{0.18})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
83	$(Mg_{0.19}Co_{0.19}Ni_{0.19}Cu_{0.24}Zn_{0.19})O$	Rock salt	Fm-3m			Single	10.1103/PhysRevMaterials.3.104421
84	(CoCuMgNiZnGd)O	Rock salt	Fm-3m			Single	10.1016/j.matlet.2020.129175
85	$(Mg_{0.2}Co_{0.2}Cu_{0.2}Ni_{0.2}Zn_{0.2})O$	Rock salt	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.018
86	$(CeGdLaPrY)_2O_3$	Bixbyite	Ia-3			Single	10.1111/jace.16971
87	$(Gd_{0.4}Tb_{0.4}Dy_{0.4}Ho_{0.4}Er_{0.4}O_3$	Cubic Bixbyite	Ia-3			Single	10.1111/jace.16689
88	$(Lu_{0.167}Y_{0.167}Ho_{0.167}Dy_{0.167}Tb_{0.167}Gd_{0.167})_3Al_5O_{12}$	Garnet	Ia-3d			Single	10.1021/acs.cgd.0c00887
89	$(Al_{0.19}Cr_{0.13}Nb_{0.19}Ta_{0.30}Ti_{0.19})O_2$	Rutile	P_{42}/mnm			Single	10.1016/j.vacuum.2019.108850
90	$(Ba_{0.7}Sr_{0.3})(Fe_{2.9}Al_{2.5}Mn_3Ti_1Ni_{2.9})O_{19}$	Magnetoplumbite	P_{63}/mmc			Single	10.1016/j.ceramint.2019.03.221
91	$(Ce_{0.2}La_{0.2}Pr_{0.2}Sm_{0.2}Y_{0.2})O_3$	Perovskite	Pbmn			Single	10.1016/j.scriptamat.2019.02.039
92	$(Gd_{0.2}Nd_{0.2}La_{0.2}Sm_{0.2}Y_{0.2})CoO_3$	Perovskite	Pbmn			Single	10.1021/acsaelm.0c00559
93	$La(Cr_{0.2}Mn_{0.2}Fe_{0.2}Co_{0.2}Ni_{0.2})O_3$	Perovskite	Pbnm			Single	10.1103/PhysRevMaterials.4.014404
94	$(Gd_{0.2}La_{0.2}Nd_{0.2}Sm_{0.2}Y_{0.2})MnO_3$	Perovskite	Pbnm			Single	10.1063/5.0004125
95	$Y(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})O_3$	Perovskite	Pbnm			Single	10.1063/5.0004125
96	$(Bi_{0.2}Na_{0.2}K_{0.2}Ba_{0.2}Ca_{0.2})TiO_3$	Perovskite	Pm-3m			Single	10.1016/j.ceramint.2020.05.090
97	$Sr(Ti_{0.2}Y_{0.2}Zr_{0.2}Sn_{0.2}Hf_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1016/j.ceramint.2020.04.060
98	$Ba(Mg_{0.2}Zn_{0.2}Ti_{0.2}W_{0.2}Mo_{0.2})O$	Perovskite	Pm-3m			Single	10.2139/ssrn.3656143
99	$Sr(Ti_{0.2}Fe_{0.2}Mo_{0.2}Nb_{0.2}Cr_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1021/acssuschemeng.0c03849
100	$(Na_{0.2}K_{0.2}Ca_{0.2}La_{0.2}Ce_{0.2})TiO_3$	Perovskite	Pm-3m			Single	10.3390/nano10020268
101	$Sr(Zr_{0.2}Sn_{0.2}Ti_{0.2}Hf_{0.2}Mn_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1016/j.scriptamat.2017.08.040
102	$Ba(Zr_{0.2}Sn_{0.2}Ti_{0.2}Hf_{0.2}Ce_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1016/j.scriptamat.2017.08.040
103	$Ba(Zr_{0.2}Ti_{0.2}Sn_{0.2}Hf_{0.2}Y_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1016/j.ceramint.2019.11.239
104	$(Na_{0.2}Bi_{0.2}Ba_{0.2}Sr_{0.2}Ca_{0.2})TiO_3$	Perovskite	Pm-3m			Single	10.1063/1.5126652
105	$Ba_{0.5}Sr_{0.5}(Zr_{0.4}Hf_{0.3}Ti_{0.2}Fe_{0.3})O_3$	Perovskite	Pm-3m			Single	10.1002/cssc.201902705
106	$Sr(Zr_{0.188}Y_{0.012}Sn_{0.2}Ti_{0.2}Hf_{0.2}Mn_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1080/21870764.2019.1595931
107	$Ba(Zr_{0.2}Sn_{0.2}Ti_{0.2}Hf_{0.2}Nb_{0.2})O_3$	Perovskite	Pm-3m			Single	10.1103/PhysRevMaterials.2.060404
108	$(La_{0.2}Pr_{0.2}Nd_{0.2}Sm_{0.2}Eu_{0.2})NiO_3$	Perovskite	Pm-3m			Single	10.1063/1.5133710
109	$La_{0.4}Pr_{0.3}Ca_{0.1}Sr_{0.2}MnO_3$	Perovskite	Pm-3m			Single	10.1038/s41598-020-76321-w
110	$Zr_{0.2}Sn_{0.2}Ti_{0.2}Hf_{0.2}Ce_{0.2}O_3$	Perovskite	Pm-3m			Single	10.1021/acsmaterialslett.0c00257
111	$Y(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})O_3$	Perovskite	Pbnm			Single	10.1103/PhysRevMaterials.3.034406
112	$(GdEuSmNdLaDyHo)_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
113	$(SmEuTbDyLu)_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
114	$(LaNdSmGdYb)_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
115	$Sm2(TiZrHfSn)_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
116	$Gd2(TiZrHfSn)_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
117	$(LaCeNdSmEu)_2Zr_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025

118	$(YYbErLu)_2(ZrHf)_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
119	$Y_2(TiZrHfMoV)_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
120	$Y_2(TiHfMoV)_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
121	$Y_2(TiZrHfMo)_2O_7$	Pyrochlore	Fd-3m			Single	10.1016/j.jmst.2020.12.025
122	$(CoMgMnNiZn)(AlCoCrFeMn)_2O_4$	Spinel	Fd-3m			Single	[70]
123	$(CrFeMnCoZn)_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jmmm.2019.165884
124	$(CrFeMnNiZn)_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jmmm.2019.165884
125	$(AlCoCrFeMnNi)_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jmmm.2020.166594
126	$(CrMnFeNiCu)_3O_4$	Spinel	Fd-3m			Single	10.1016/j.cej.2021.132658
127	$(MgCoNiCuZn)Cr_2O_4$	Spinel	Fd-3m			Single	https://doi.org/10.1016/j.scriptamat.2020.03.033
128	$(CoCuMgNiZn)TiO_4$	Spinel	Fd-3m			Single	10.1016/j.jallcom.2021.161390
129	$(MgFeCoNiCu)Cr_2O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
130	$(CoZnFeMnNi)_3O_4$	Spinel	Fd-3m			Single	10.1016/j.jmmm.2021.168123
131	$(ZnCuMgCo)Al_2O_4$	Spinel	Fd-3m			Single	10.1515/zpch-2021-3106
132	$(CoCrFeMnNi)_3O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
133	$(CoCuMgMnNi)Fe_2O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
134	$(CoCuFeMnNi)Fe_2O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
135	$(CoCuMgNiZn)Fe_2O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
136	$(CoCuMgMnNi)Cr_2O_4$	Spinel	Fd-3m			Single	10.1103/PhysRevMaterials.3.104416
137	$(HfZrCeY)O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
138	$(Hf_{0.25}Zr_{0.25}Ce_{0.25}Y_{0.125}Yb_{0.125})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
139	$(HfZrCeYYb)O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
140	$(Hf_{0.25}Zr_{0.25}Ce_{0.25}Y_{0.125}Ca_{0.125})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
141	$(Hf_{0.25}Zr_{0.25}Ce_{0.25}Y_{0.125}Gd_{0.125})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
142	$(HfZrCeYGd)O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
143	$(Hf_{0.25}Zr_{0.25}Ce_{0.25}Yb_{0.125}Gd_{0.125})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
144	$(HfZrCeYbGd)O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2018.04.010
145	$(Zr_{0.942}Y_{0.058})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
146	$(Zr_{0.852}Y_{0.148})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
147	$(HfZrCeY_{0.25}Yb_{0.25})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
148	$(HfZrCeYYb)O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
149	$(HfZrCeY_{0.09}Ca_{0.09})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
150	$(HfZrCeY_{0.25}Ca_{0.25})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
151	$(HfZrCeY_{0.25}Gd_{0.25})O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
152	$(HfZrCeYGd)O_2$	Fluorite	Fm-3m			Single	10.1016/j.jeurceramsoc.2020.01.015
153	$(GdLaNdSmY)(CoCrFeMnNi)O_3$	Perovskite - Orthohombic	Pbnm			Single	10.1016/j.scriptamat.2019.02.039
154	$Gd(CoCrFeMnNi)O_3$	Perovskite - Orthohombic	Pbnm			Single	10.1103/PhysRevMaterials.3.034406
155	$Nd(CoCrFeMnNi)O_3$	Perovskite - Orthohombic	Pbnm			Single	10.1103/PhysRevMaterials.3.034406
156	$Sm(CoCrFeMnNi)O_3$	Perovskite - Orthohombic	Pbnm			Single	10.1103/PhysRevMaterials.3.034406
157	$Y(CoCrFeMnNi)O_3$	Perovskite - Orthohombic	Pbnm			Single	10.1103/PhysRevMaterials.3.034406