Electronic Supporting Information

Single Crystalline Ternary Mixed Metal Oxide 1-Dimensional Nanostructures of $Ir_{1-x-y}Ru_xV_yO_2$ by Vapour Phase Transport

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Table. S1.

$Ir_{1-x-y}Ru_xV_yO_2$	XRD 2θ (degree)	XRD d(110) (Å)	Calculated d(110) (Å)	Error (%)
$Ir_{0.06}Ru_{0.41}V_{0.53}O_2$	27.68	3.223	3.200	0.715
$Ir_{0.10}Ru_{0.36}V_{0.54}O_2$	27.78	3.211	3.201	0.333
$Ir_{0.12}Ru_{0.34}V_{0.54}O_2$	27.76	3.214	3.202	0.366
$Ir_{0.14}Ru_{0.74}V_{0.12}O_2$	28.18	3.167	3.182	0.493
$Ir_{0.23}Ru_{0.34}V_{0.43}O_2$	27.78	3.211	3.197	0.446
$Ir_{0.39}Ru_{0.37}V_{0.24}O_2$	28.00	3.187	3.190	0.113
$Ir_{0.40}Ru_{0.44}V_{0.16}O_2$	28.10	3.175	3.187	0.353

* d(110) for IrO_2 : 3.186 Å, d(110) for RuO_2 : 3.176 Å, d(110) for VO_2 : 3.220 Å
* Copper X-ray Wavelength : 1.5418 pm

Table. S1. The *d*-spacing values for the crystallographic planes of (110) of various compositions of $Ir_{1-x-y}Ru_xV_yO_2$ ternary mixed metal oxide nanowires from XRD measurements and estimated ones with reference data from JCPDS.

Fig. S1

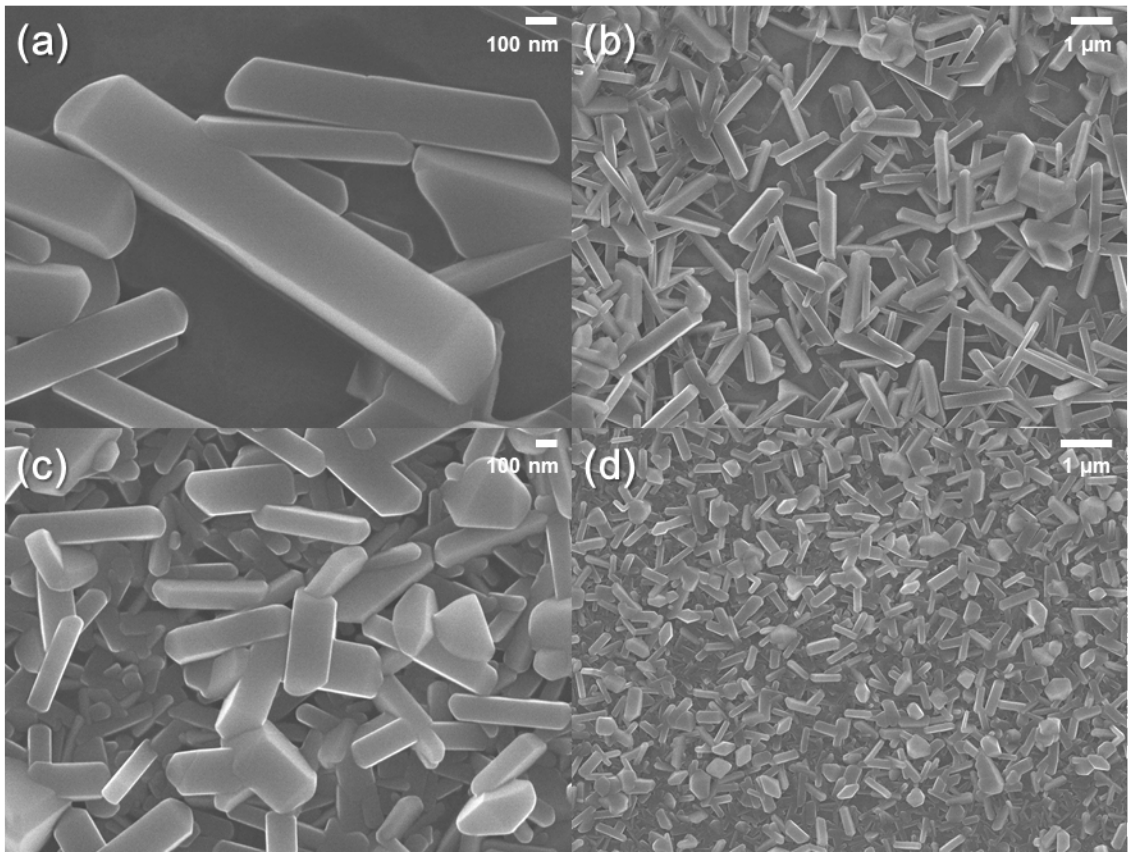


Fig. S1 SEM images of as-grown iridium-ruthenium-vanadium ternary mixed metal oxide nanowires on a Si(001) substrate by a vapour transport process. (a) and (b) $Ir_{0.06}Ru_{0.41}V_{0.53}O_2$, (c) and (d) $Ir_{0.10}Ru_{0.36}V_{0.54}O_2$.

Fig. S2.

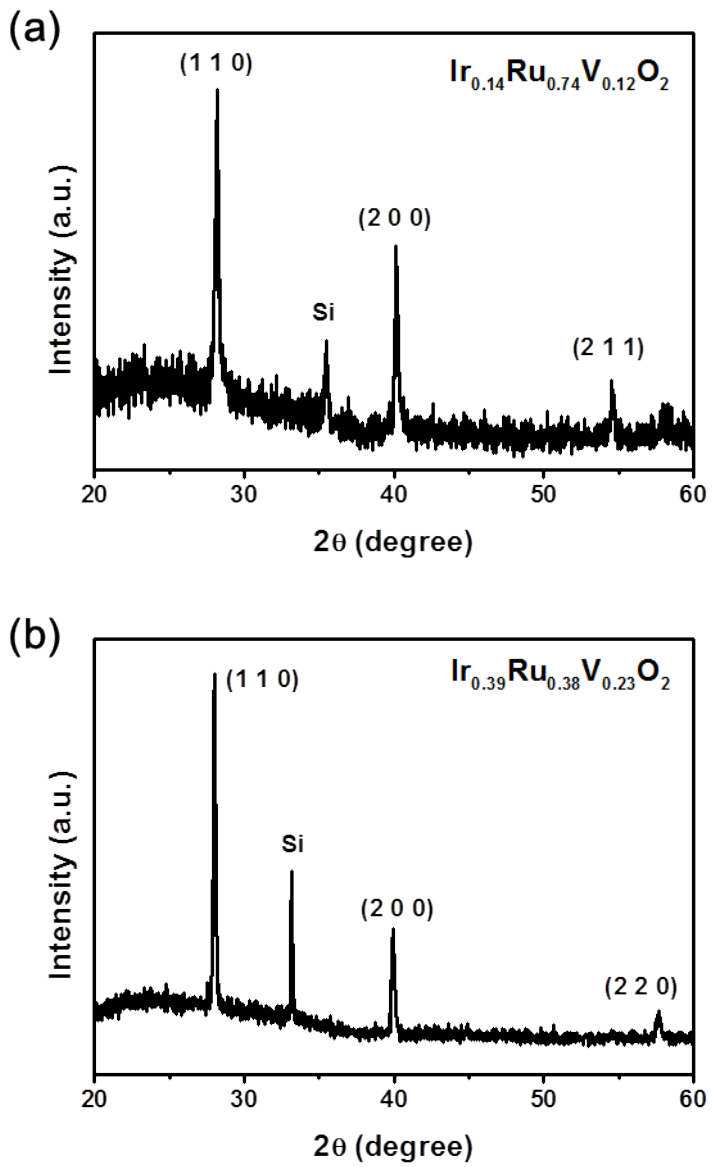
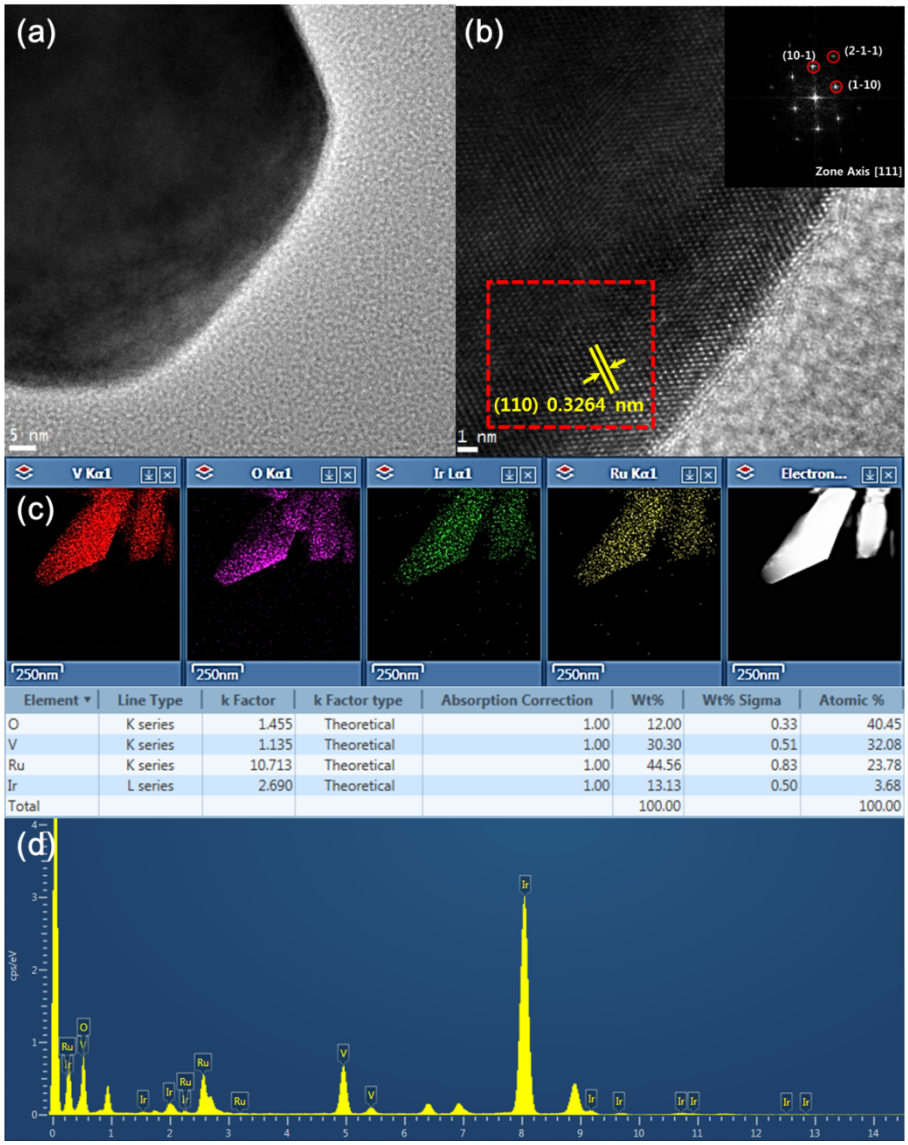


Fig. S2. XRD patterns of $Ir_{1-x-y}Ru_xV_yO_2$ ternary mixed metal oxide nanowires at a variety of compositions.

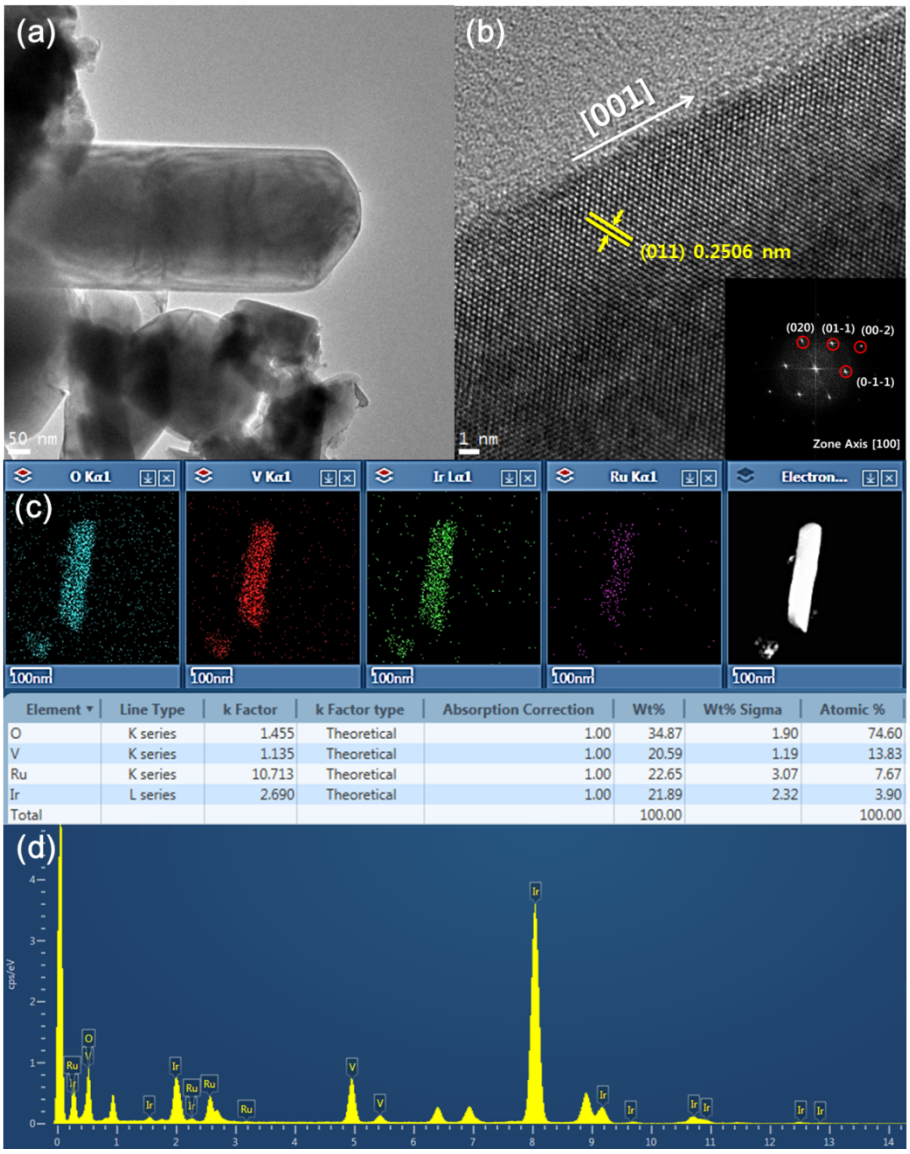
Fig. S3.



Element	Line Type	k Factor	k Factor type	Absorption Correction	Wt%	Wt% Sigma	Atomic %
O	K series	1.455	Theoretical	1.00	12.00	0.33	40.45
V	K series	1.135	Theoretical	1.00	30.30	0.51	32.08
Ru	K series	10.713	Theoretical	1.00	44.56	0.83	23.78
Ir	L series	2.690	Theoretical	1.00	13.13	0.50	3.68
Total					100.00		100.00

Fig. S3. (a) The low magnification TEM images and (b) the lattice resolved HRTEM image of a single $Ir_{0.06}Ru_{0.41}V_{0.53}O_2$ ternary mixed metal oxide nanowire. (c) EDS-elemental mapping analysis for Ir(L), Ru(K) and V(K) atoms and (d) EDS spectrum of a single $Ir_{0.06}Ru_{0.41}V_{0.53}O_2$ ternary mixed metal oxide nanowire.

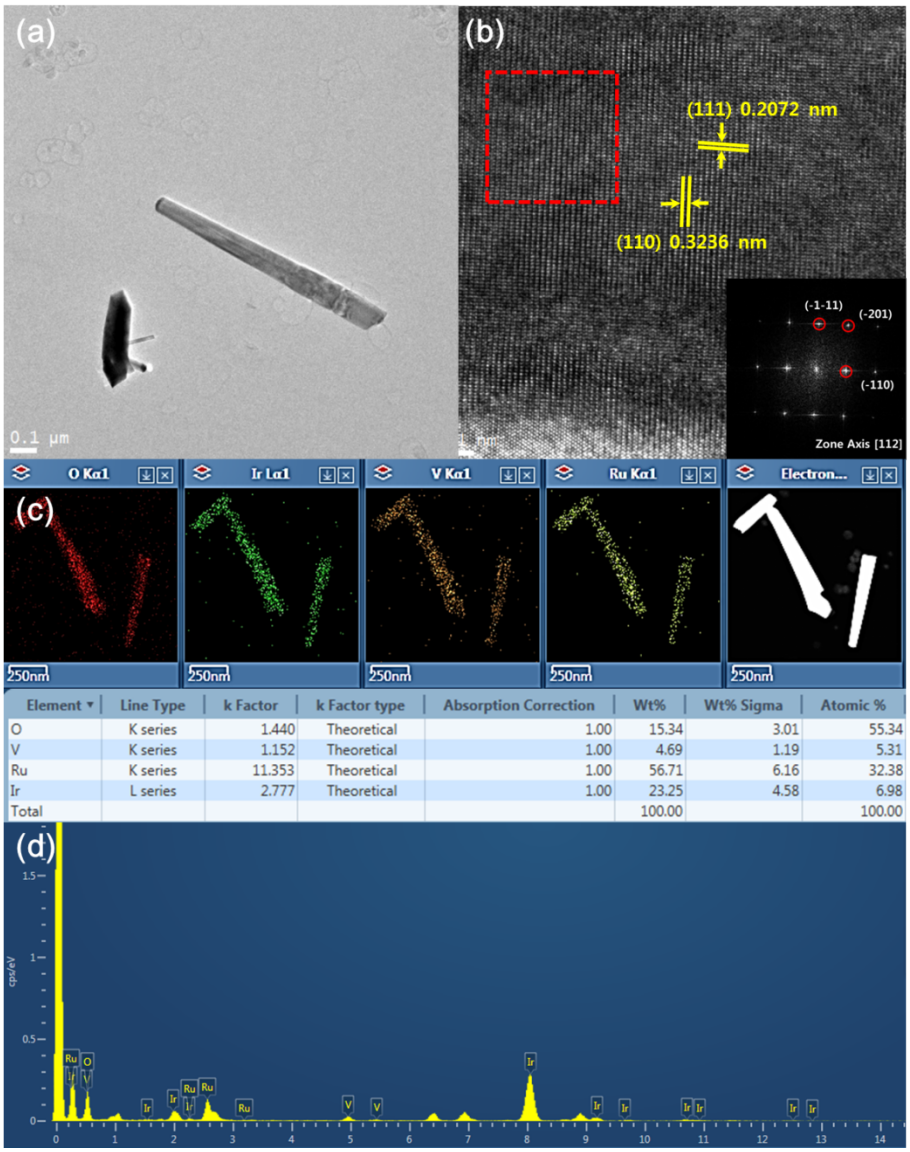
Fig. S4.



Element	Line Type	k Factor	k Factor type	Absorption Correction	Wt%	Wt% Sigma	Atomic %
O	K series	1.455	Theoretical	1.00	34.87	1.90	74.60
V	K series	1.135	Theoretical	1.00	20.59	1.19	13.83
Ru	K series	10.713	Theoretical	1.00	22.65	3.07	7.67
Ir	L series	2.690	Theoretical	1.00	21.89	2.32	3.90
Total					100.00		100.00

Fig. S4. (a) The low magnification TEM images and (b) the lattice resolved HRTEM image of a single $Ir_{0.10}Ru_{0.36}V_{0.54}O_2$ ternary mixed metal oxide nanowire. (c) EDS-elemental mapping analysis for Ir(L), Ru(K) and V(K) atoms and (d) EDS spectrum of a single $Ir_{0.10}Ru_{0.36}V_{0.54}O_2$ ternary mixed metal oxide nanowire.

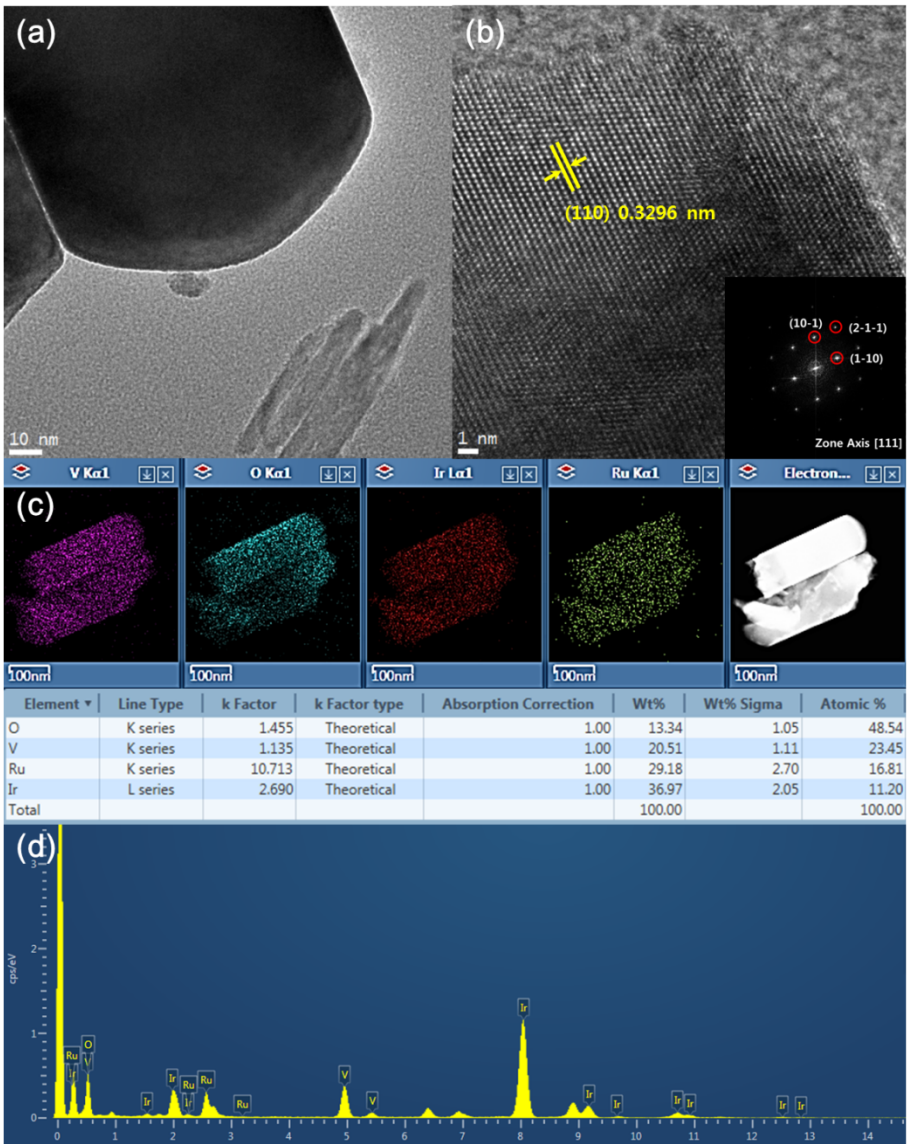
Fig. S5.



Element	Line Type	k Factor	k Factor type	Absorption Correction	Wt%	Wt% Sigma	Atomic %
O	K series	1.440	Theoretical	1.00	15.34	3.01	55.34
V	K series	1.152	Theoretical	1.00	4.69	1.19	5.31
Ru	K series	11.353	Theoretical	1.00	56.71	6.16	32.38
Ir	L series	2.777	Theoretical	1.00	23.25	4.58	6.98
Total					100.00		100.00

Fig. S5. (a) The low magnification TEM images and (b) the lattice resolved HRTEM image of a single $Ir_{0.14}Ru_{0.74}V_{0.12}O_2$ ternary mixed metal oxide nanowire. (c) EDS-elemental mapping analysis for Ir(L), Ru(K) and V(K) atoms and (d) EDS spectrum of a single $Ir_{0.14}Ru_{0.74}V_{0.12}O_2$ ternary mixed metal oxide nanowire.

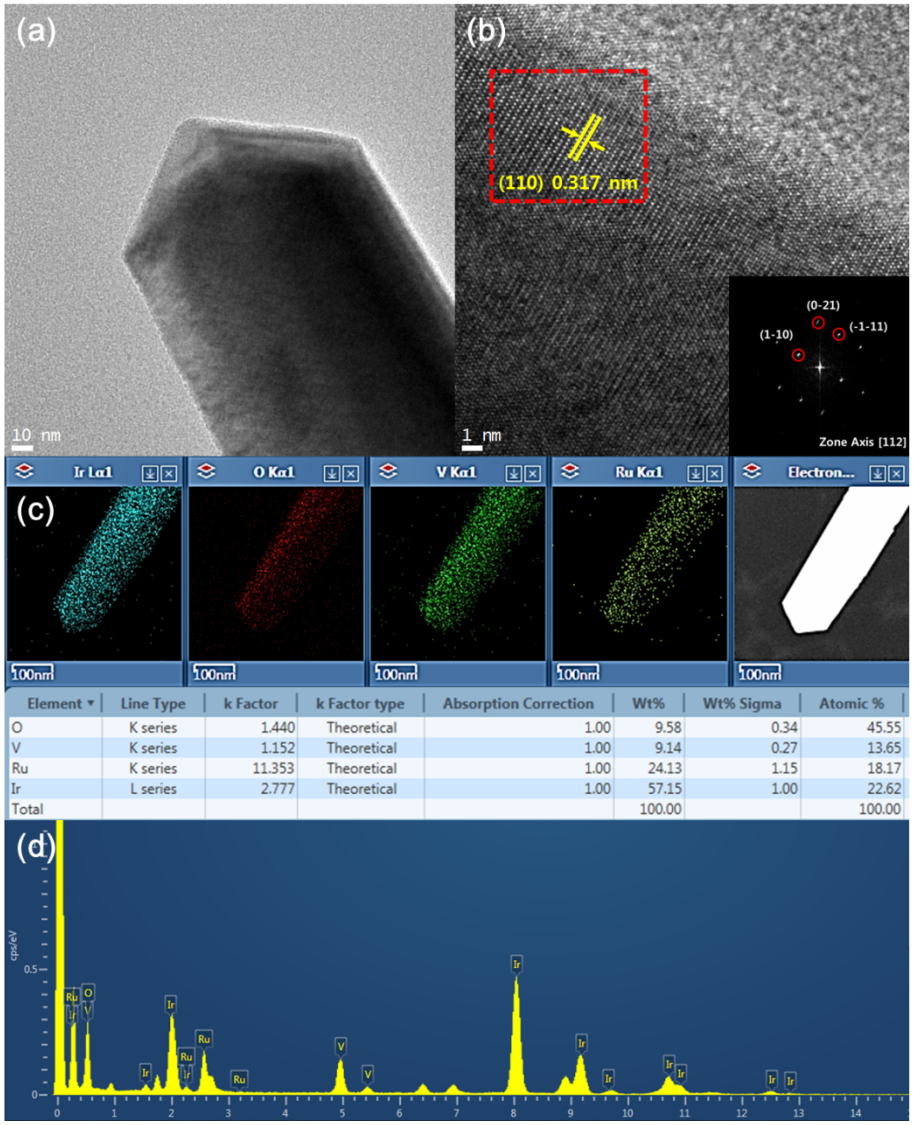
Fig. S6.



Element	Line Type	k Factor	k Factor type	Absorption Correction	Wt%	Wt% Sigma	Atomic %
O	K series	1.455	Theoretical	1.00	13.34	1.05	48.54
V	K series	1.135	Theoretical	1.00	20.51	1.11	23.45
Ru	K series	10.713	Theoretical	1.00	29.18	2.70	16.81
Ir	L series	2.690	Theoretical	1.00	36.97	2.05	11.20
Total					100.00		100.00

Fig. S6. (a) The low magnification TEM images and (b) the lattice resolved HRTEM image of a single $Ir_{0.23}Ru_{0.34}V_{0.43}O_2$ ternary mixed metal oxide nanowire. (c) EDS-elemental mapping analysis for Ir(L), Ru(K) and V(K) atoms and (d) EDS spectrum of a single $Ir_{0.23}Ru_{0.34}V_{0.43}O_2$ ternary mixed metal oxide nanowire.

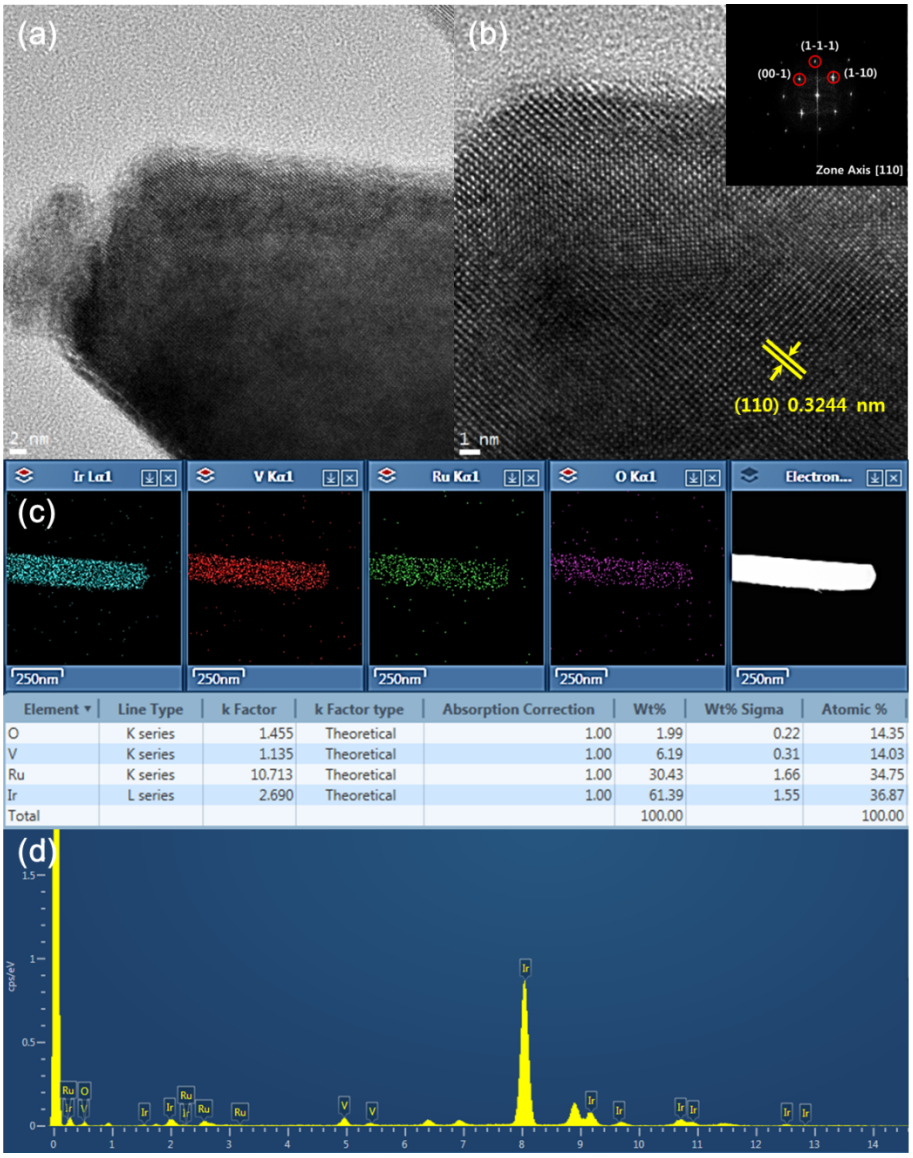
Fig. S7.



Element	Line Type	k Factor	k Factor type	Absorption Correction	Wt%	Wt% Sigma	Atomic %
O	K series	1.440	Theoretical	1.00	9.58	0.34	45.55
V	K series	1.152	Theoretical	1.00	9.14	0.27	13.65
Ru	K series	11.353	Theoretical	1.00	24.13	1.15	18.17
Ir	L series	2.777	Theoretical	1.00	57.15	1.00	22.62
Total					100.00		100.00

Fig. S7. (a) The low magnification TEM images and (b) the lattice resolved HRTEM image of a single $Ir_{0.39}Ru_{0.37}V_{0.24}O_2$ ternary mixed metal oxide nanowire. (c) EDS-elemental mapping analysis for Ir(L), Ru(K) and V(K) atoms and (d) EDS spectrum of a single $Ir_{0.39}Ru_{0.37}V_{0.24}O_2$ ternary mixed metal oxide nanowire.

Fig. S8.



Element	Line Type	k Factor	k Factor type	Absorption Correction	Wt%	Wt% Sigma	Atomic %
O	K series	1.455	Theoretical	1.00	1.99	0.22	14.35
V	K series	1.135	Theoretical	1.00	6.19	0.31	14.03
Ru	K series	10.713	Theoretical	1.00	30.43	1.66	34.75
Ir	L series	2.690	Theoretical	1.00	61.39	1.55	36.87
Total					100.00		100.00

Fig. S8. (a) The low magnification TEM images and (b) the lattice resolved HRTEM image of a single $Ir_{0.40}Ru_{0.44}V_{0.16}O_2$ ternary mixed metal oxide nanowire. (c) EDS-elemental mapping analysis for Ir(L), Ru(K) and V(K) atoms and (d) EDS spectrum of a single $Ir_{0.40}Ru_{0.44}V_{0.16}O_2$ ternary mixed metal oxide nanowire.

Fig. S9.

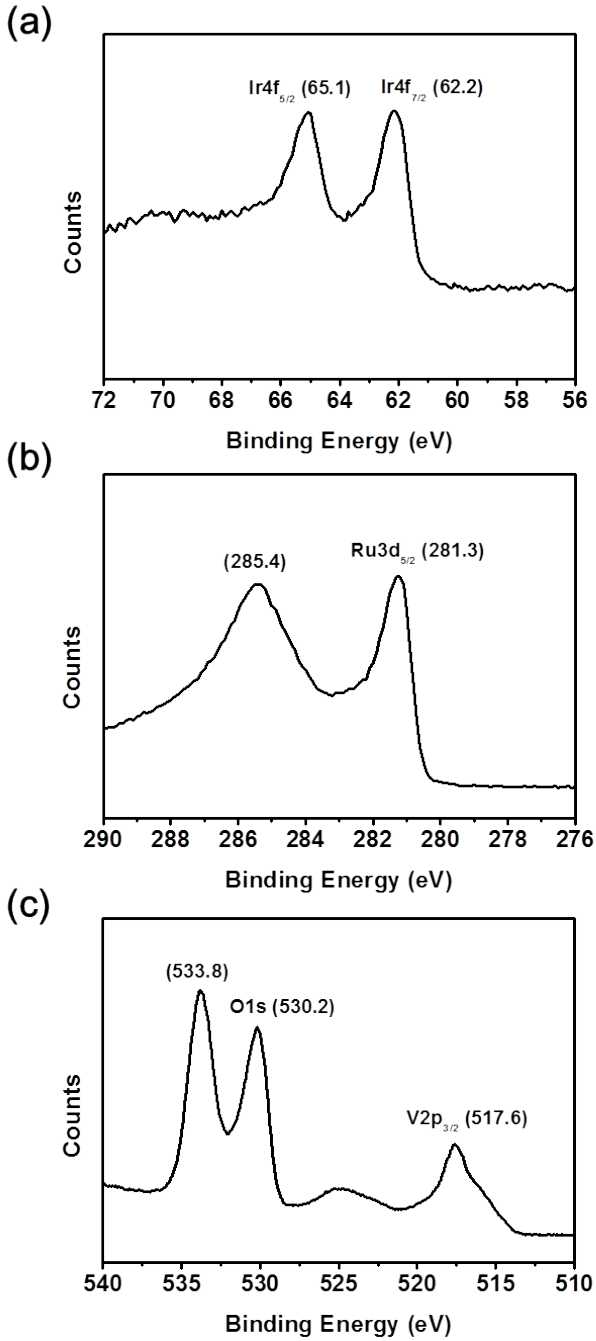


Fig. S9. X-ray Photoelectron Spectroscopy (XPS) data of $Ir_{0.06}Ru_{0.41}V_{0.53}O_2$ mixed metal oxide nanowires for (a) Ir 4f, (b) Ru 3d, and (c) V 2p.

Fig. S10.

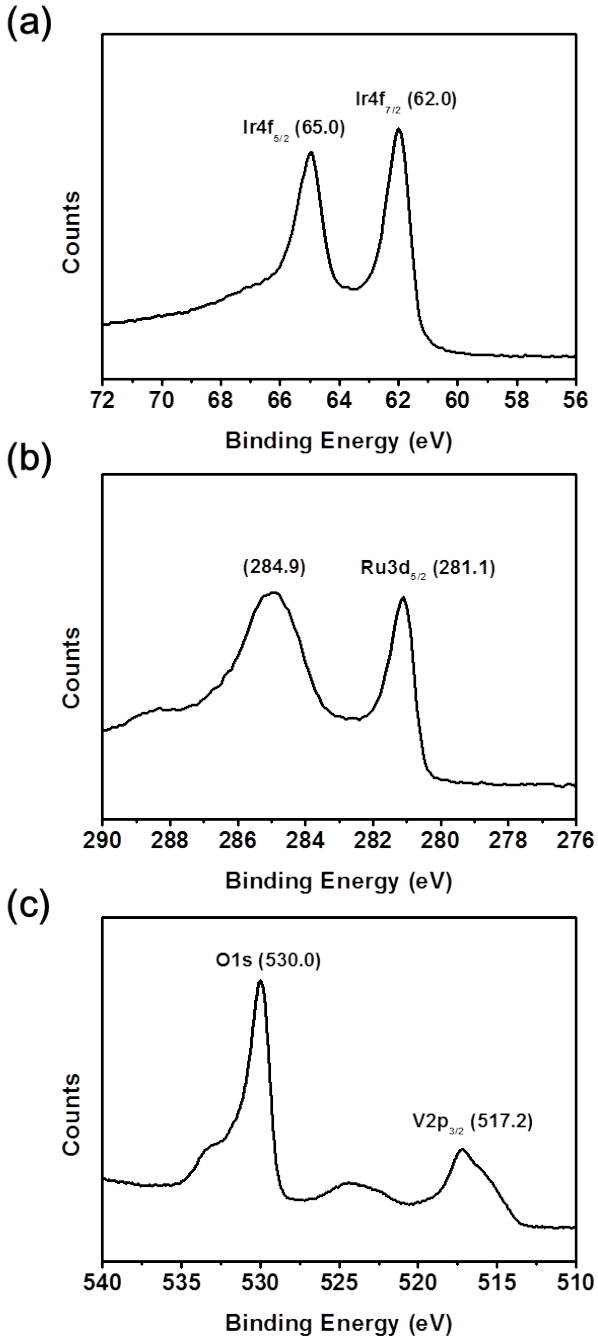


Fig. S10. X-ray Photoelectron Spectroscopy (XPS) data of $Ir_{0.10}Ru_{0.36}V_{0.54}O_2$ mixed metal oxide nanowires for (a) Ir 4f, (b) Ru 3d, and (c) V 2p.

Fig. S11.

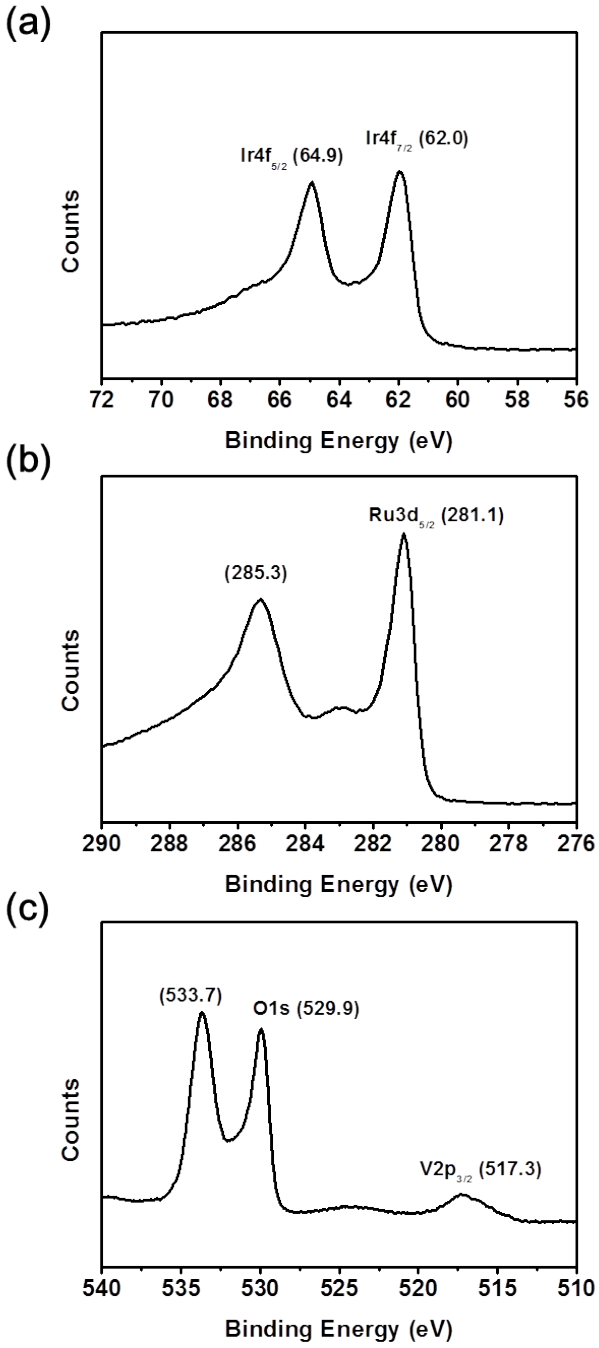


Fig. S11. X-ray Photoelectron Spectroscopy (XPS) data of $Ir_{0.14}Ru_{0.74}V_{0.12}O_2$ mixed metal oxide nanowires for (a) Ir 4f, (b) Ru 3d, and (c) V 2p.

Fig. S12.

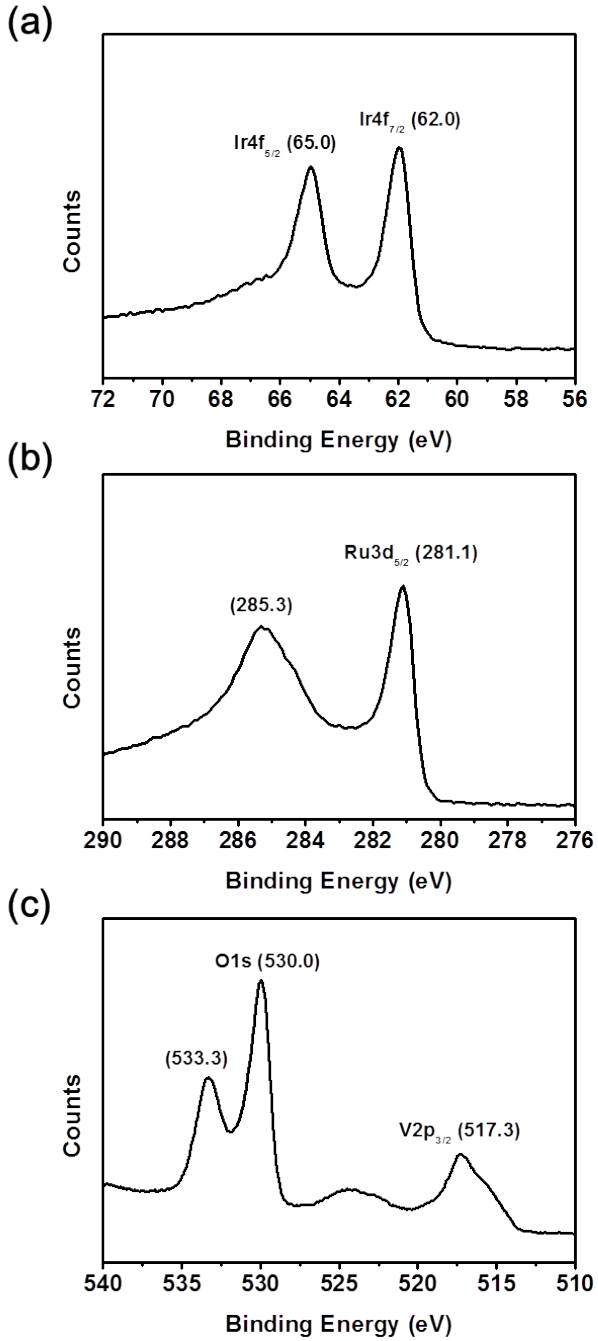


Fig. S12. X-ray Photoelectron Spectroscopy (XPS) data of $Ir_{0.23}Ru_{0.34}V_{0.43}O_2$ mixed metal oxide nanowires for (a) Ir 4f, (b) Ru 3d, and (c) V 2p.

Fig. S13.

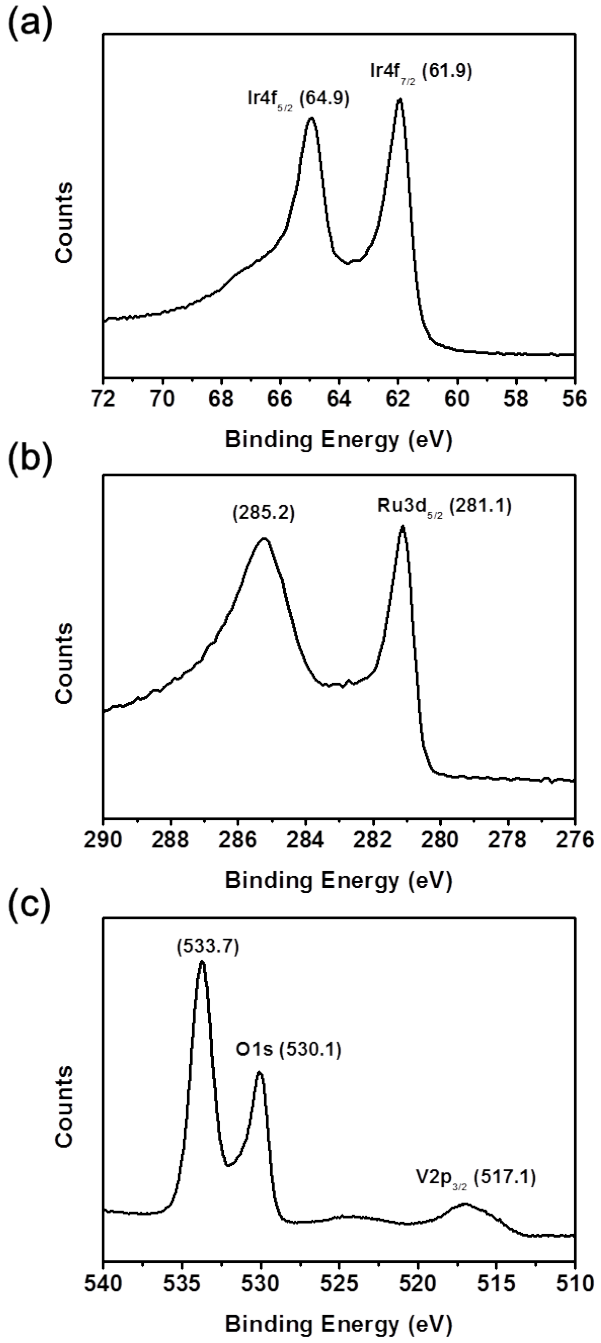


Fig. S13. X-ray Photoelectron Spectroscopy (XPS) data of $Ir_{0.39}Ru_{0.37}V_{0.24}O_2$ mixed metal oxide nanowires for (a) Ir 4f, (b) Ru 3d, and (c) V 2p.