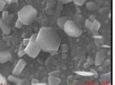
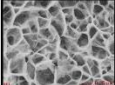
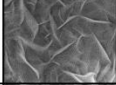
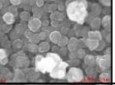
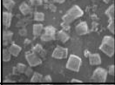
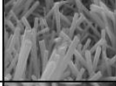
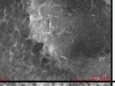
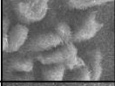
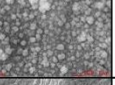
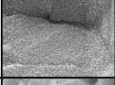
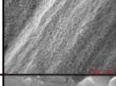
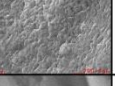
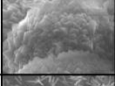
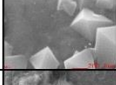
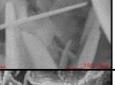
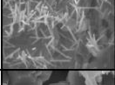
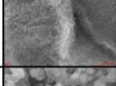
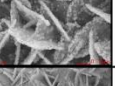
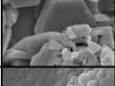
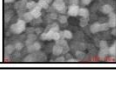
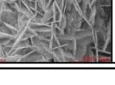
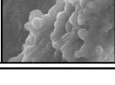


Metal oxide nanostructures by a simple hot water treatment: Supplementary information

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Table S1 Expected metal oxide compositions and measured EDS atomic compositions

Base Metal	Expected Oxide State	Top-View SEM	Atomic Composition from EDS		Base Metal	Expected Oxide State	Top-View SEM	Atomic Composition from EDS		Base Metal	Expected Oxide State	Top-View SEM	Atomic Composition from EDS	
			Metal %	Oxygen %				Metal %	Oxygen %				Metal %	Oxygen %
Al	Al ₂ O ₃		53	47	Ta	TaO		56	44	Ni	NiO		54	46
Mg	MgO		62	38	Fe	Fe ₂ O ₃		80	20	In	In ₂ O ₃		39	61
Zn	ZnO		66	34	Se	SeO ₂		84	16	V	VO		75	25
Cu	CuO		60	40	Nd	Nd ₂ O ₃		34	66	Ti	TiO ₂		60	40
Cd	CdO		53	47	Tl	Tl ₂ O		63	37	Be	BeO		below detection limit	
Mo	MoO		64	46	Pb	PbO		65	35	Er	Er ₂ O ₃		33	67
Sc	ScO		66	34	Co	CoO		54	46	Sb	Sb ₂ O ₃		35	65
Mn	MnO		75	25	Bi	Bi ₂ O ₃		37	63	Sn	SnO		62	38

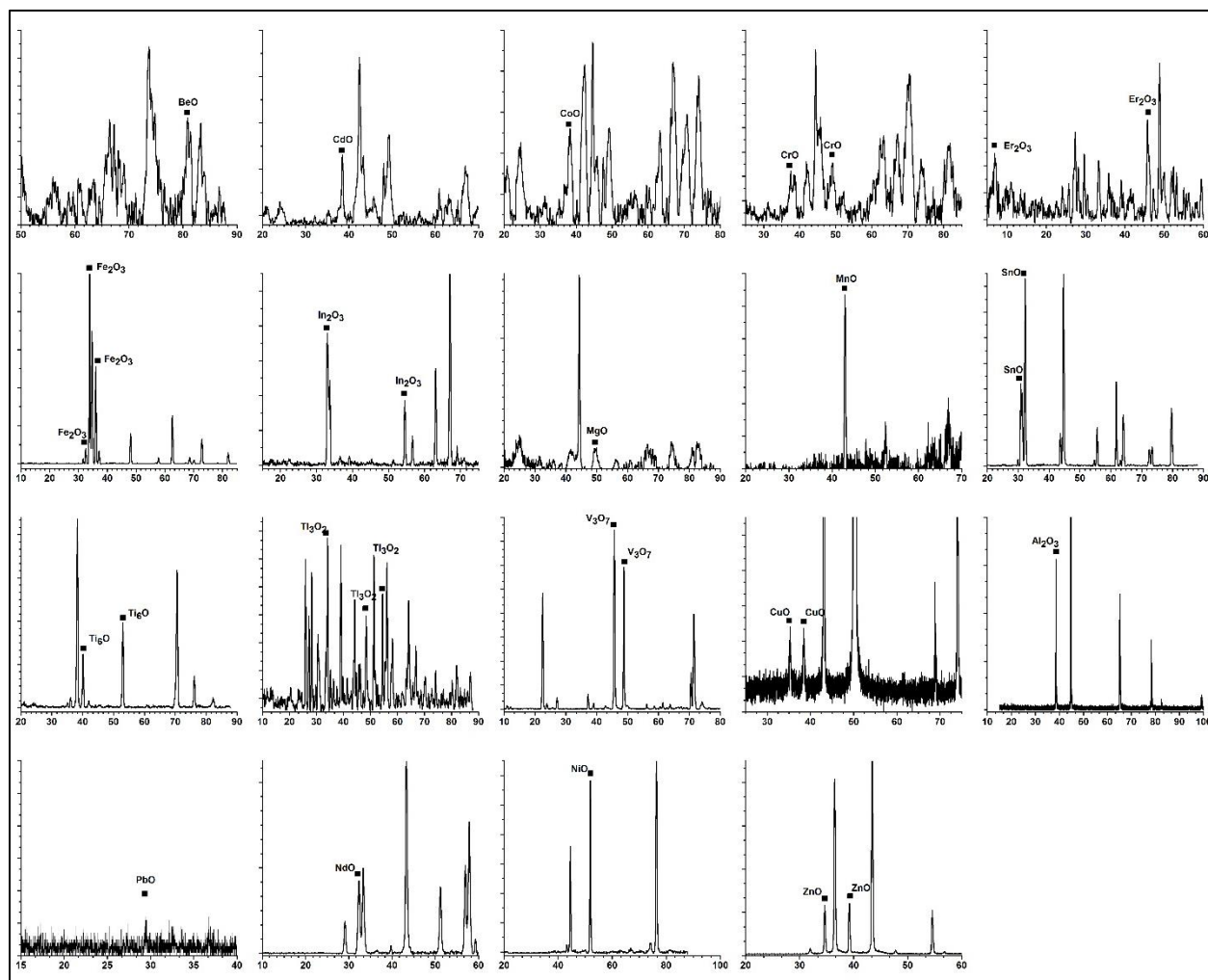
Supplementary Table 1. The table lists expected energetically stable metal oxide compositions of this study and atomic compositions measured from EDS on the selected MONSTRs shown in the top-view SEM images. (Note: EDS might have picked up signal from the base metal substrate, especially for samples of thin MONSTR layers, which overestimates metal atomic composition for some of the samples.)

Table S2 EDS Atomic compositions of metal surface before HWT

Sample	Atomic Composition from EDS		Sample	Atomic Composition from EDS		Sample	Atomic Composition from EDS	
	Base Metal %	Other %		Base Metal %	Other %		Base Metal %	Other %
Al	100	0	Ta	100	0	Ni	100	0
Mg	100	0	Fe	97	C:3	In	100	0
Zn	100	0	Cr	98	C:2	V	99	C:1
Cu	100	0	Nd	100	0	Ti	96	C:4
Cd	95	C:5	Tl	100	0	Be	below detection limit	0
Mo	99	C:1	Pb	97	C:3	Er	100	0
Sc	100	0	Co	100	0	Sb	100	0
Mn	100	0	Bi	100	0	Sn	98	C:2

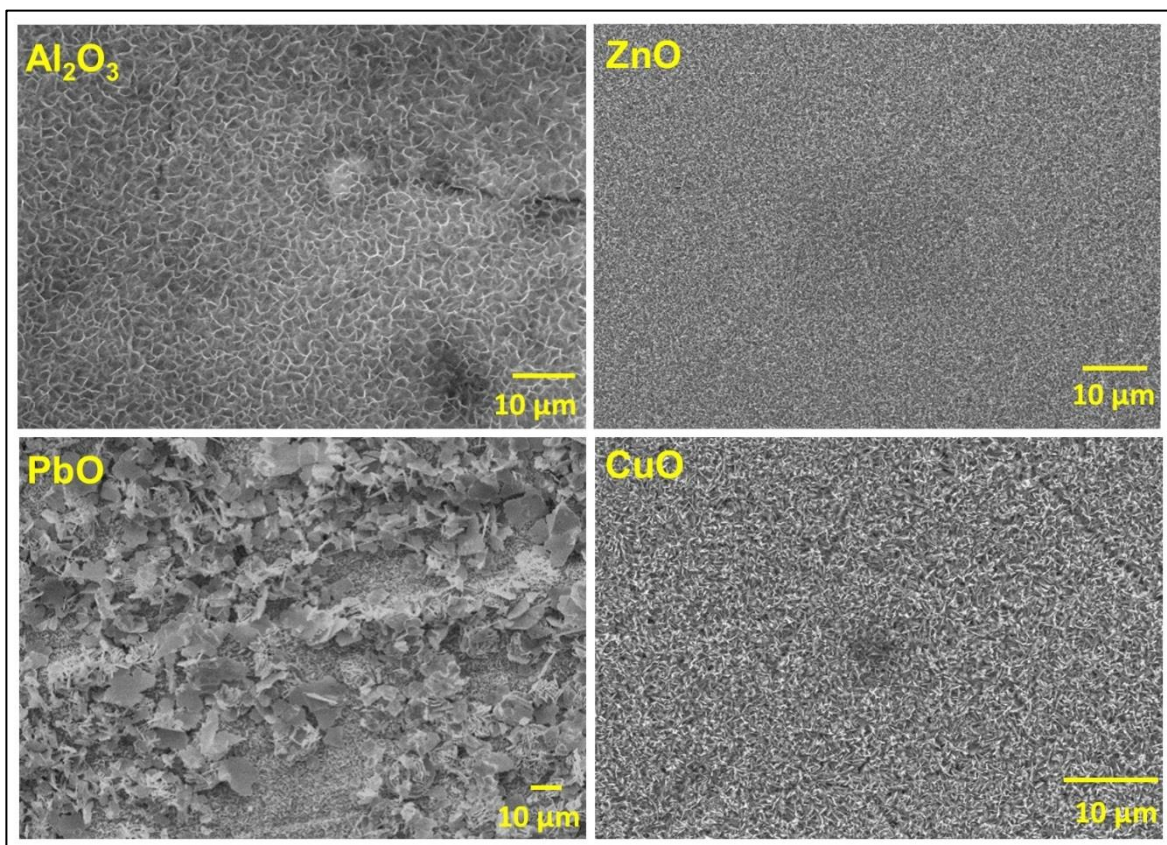
Supplementary Table 2. Atomic composition of elemental base metals of this study measured by EDS analysis on the samples after polishing and before HWT.

Figure S1 XRD profiles of HWT metal oxide nanostructures



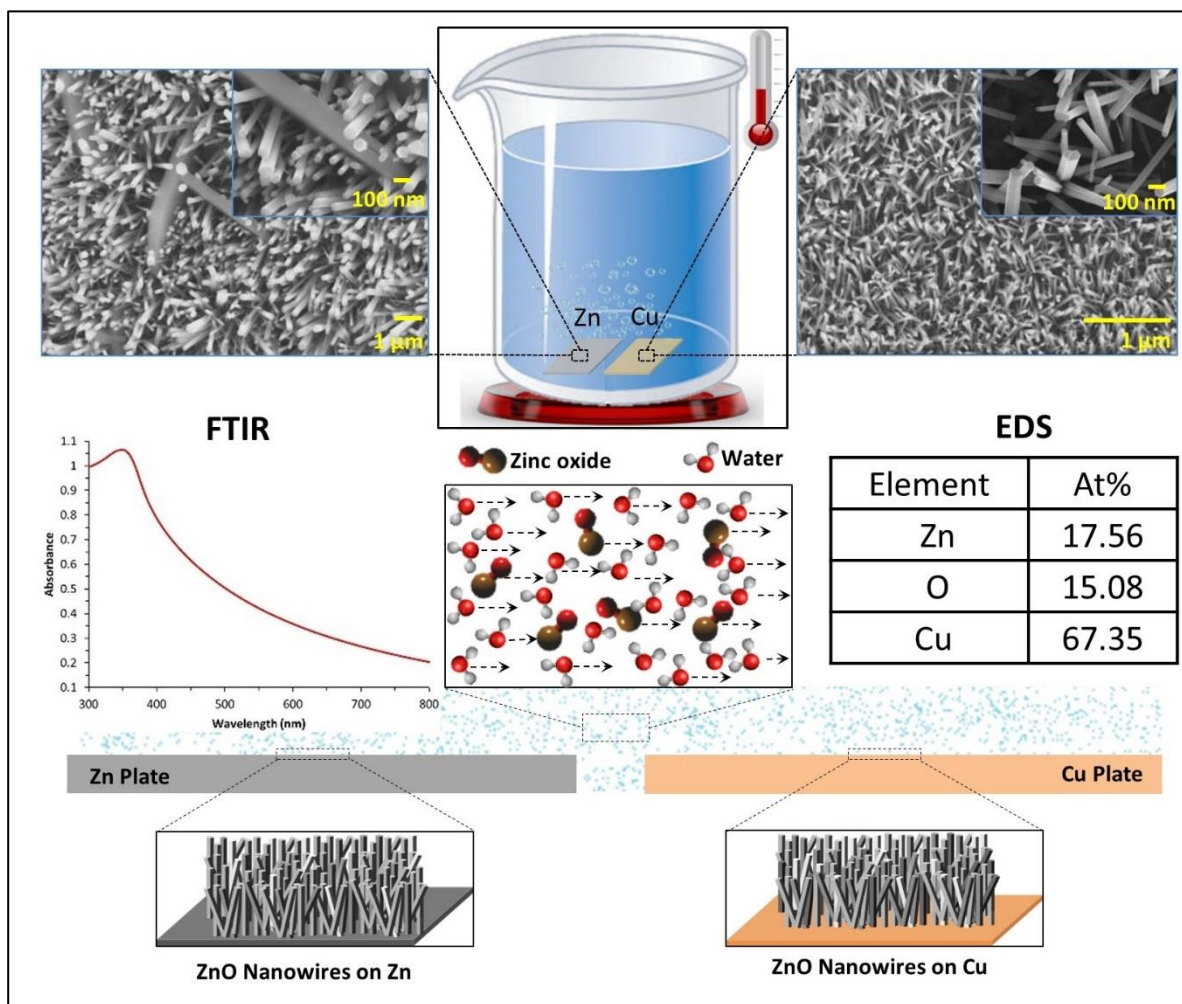
Supplementary Figure 1. θ - 2θ XRD profiles of the most dominant oxide peaks observed for the metals that responded to HWT and formed MONSTRs. Few other metals also formed MONSTRs but did not show any notable XRD peak due to the amorphous structure and/or not sufficiently thick oxide formation.

Figure S2 Low magnification SEM images of some selected metals



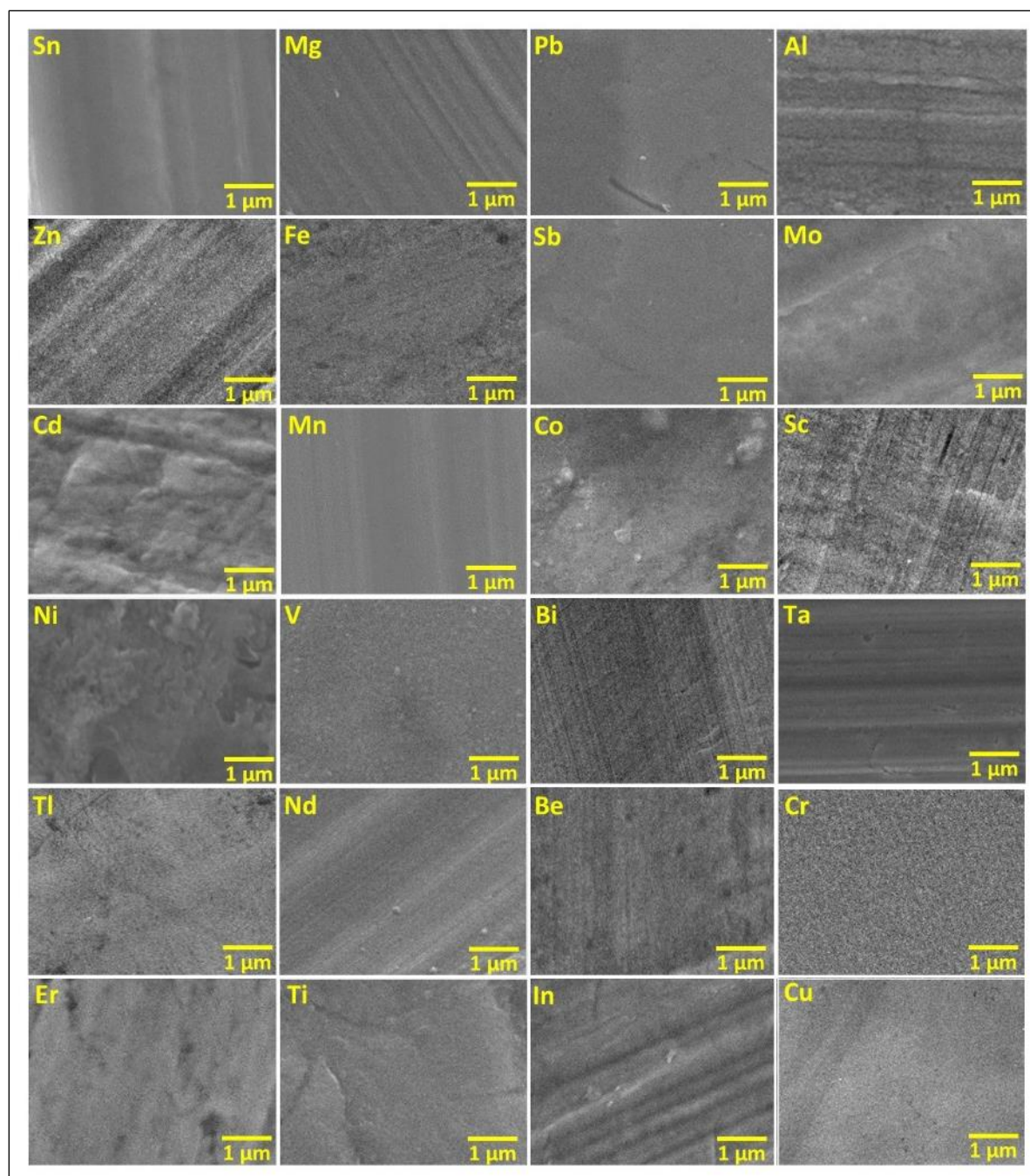
Supplementary Figure 2. Lower magnification top-view SEM images of some of the selected metals show the uniform coverage of their surface with crystalline MONSTRs after HWT. The metals selected include highly-reactive (Al, Pb, and Zn) and relatively slow-reacting (Cu) metals to HWT.

Figure S3 Plugging mechanism during HWT process



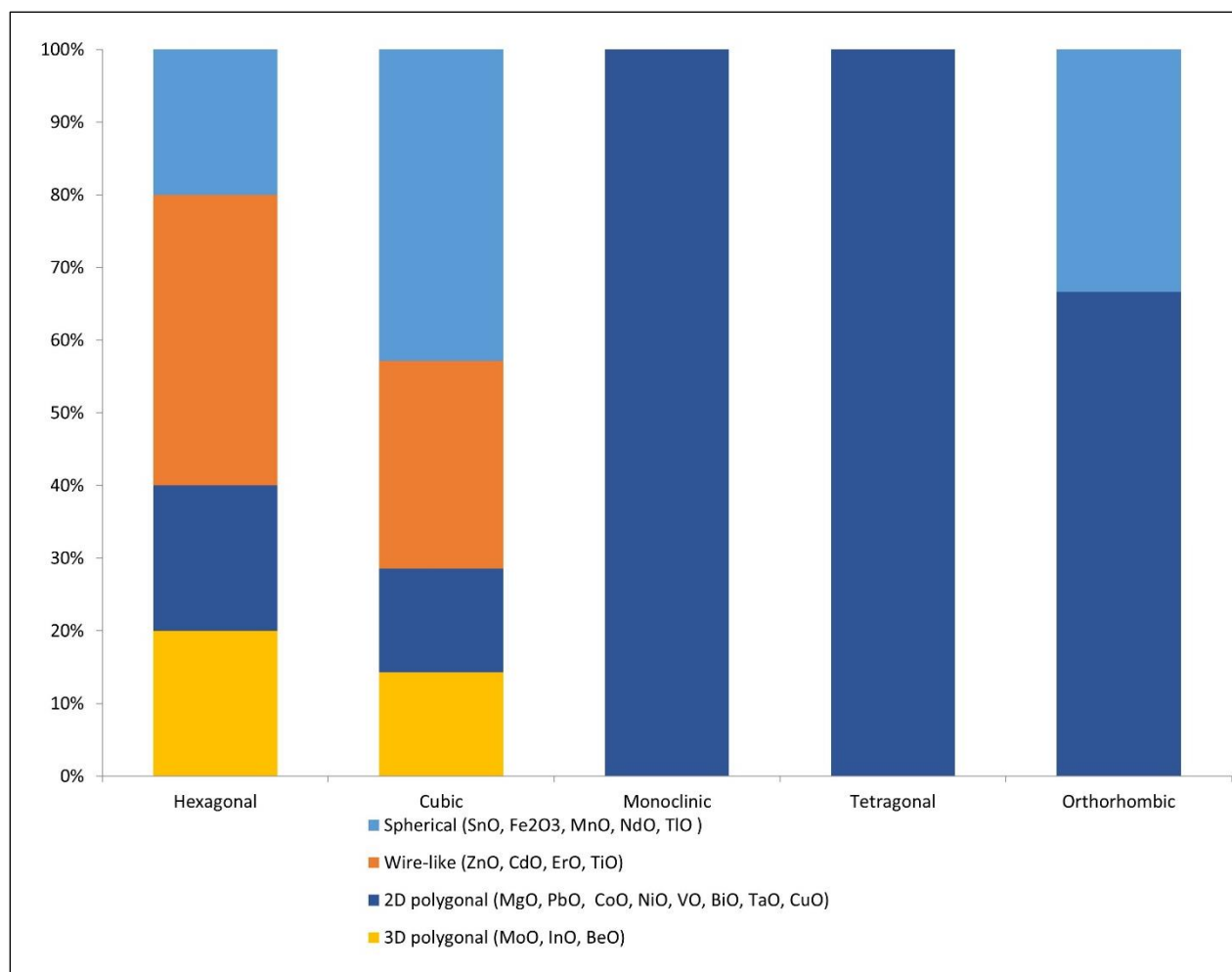
Supplementary Figure 3. A HWT experiment with Zn (left) and Cu (right) plates being treated together shows that ZnO nanorods form on the surface of copper substrate (top-view SEM image on the right), which reveal the existence of “plugging” mechanism. FTIR profile of a sample solution taken from the water during HWT also shows presence of ZnO molecules that migrates from Zn towards Cu plate. Atomic compositions measured from EDS on the Cu surface show the existence of Zn.

Figure S4 Metal surface after the cleaning process and before HWT



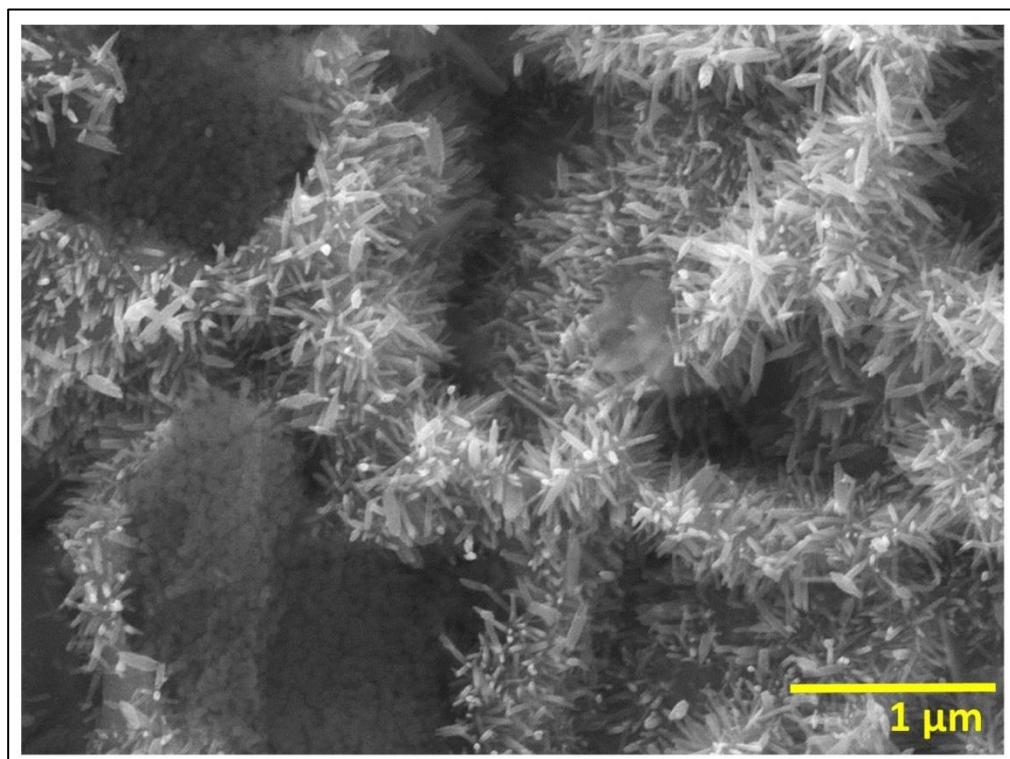
Supplementary Figure 4. Top-view SEM images metal surfaces before HWT.

Figure S5 HWT-MONSTRs shapes and their oxide crystal structure



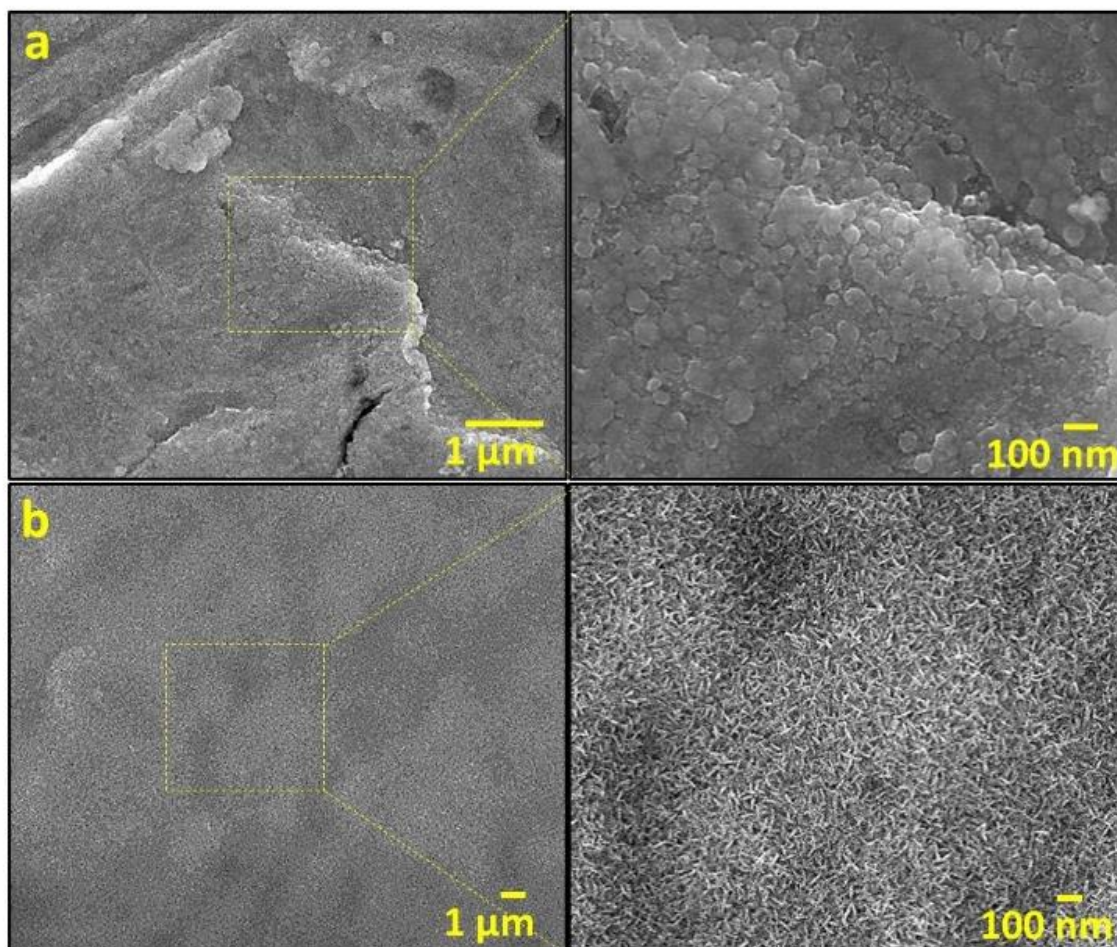
Supplementary Figure 5 Percentage distribution of basic nanostructure shapes depending on the crystal structure of MONSTRs.

Figure S6 ZnO MONSTRs on rough Zn plate



Supplementary Figure 6 Top-view SEM image of HWT ZnO MONSTRs that formed on a roughened Zn plate. The image shows that ZnO nanostructures preferentially grew on the hill-tops of the rough substrate.

Figure S7 MONSTRs formation on Cu pot surface by HWT using unpurified water and aluminum foil exposed to a steam source



Supplementary Figure 7 (a) HWT experiment with Cu pot using unpurified water and (b) Al foil being exposed to a steam source. Top-view SEM images on the right reveal the formation of MONSTRs on both Cu and Al surface.