Supplementary Information

ZnO- $BaTiO_3$ Vertically Aligned Nanocomposite (VAN) Thin Films with Tailorable Morphology and Functionalities

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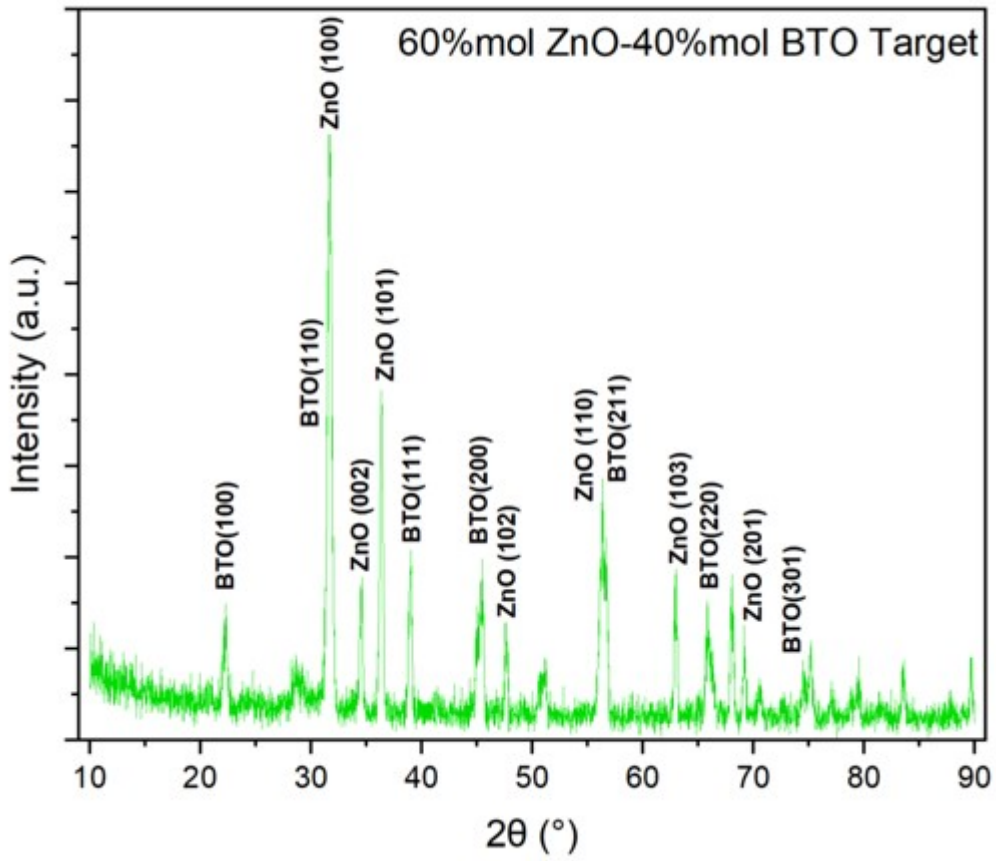

Figure S1: XRD $\theta - 2\theta$ scan of the 60%mol ZnO -40%mol BTO nanocomposite target.

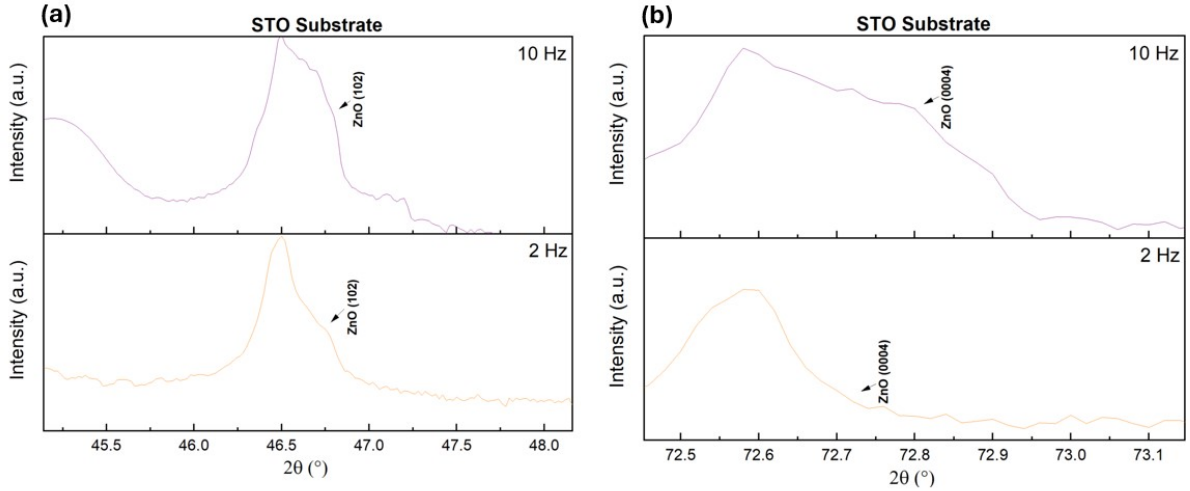

Figure S2: (a) ZnO (102) shoulder peak for 10 Hz and 2 Hz ZnO-BTO on STO. (b) ZnO(0004) shoulder peak for 10 Hz and 2 Hz ZnO-BTO on STO.

Peak	Laser Frequency	d-spacing (Å)
BTO (100) peak on STO	2hz	4.059
BTO (100) peak on STO	10hz	4.008
ZnO(0004) peak on STO	2hz	1.299
ZnO(0004) peak on STO	10hz	1.298
BTO (200) peak on Sapphire	2hz	2.009
BTO (200) peak on Sapphire	10hz	2.004
ZnO(0002) peak on Sapphire	2hz	2.583
ZnO(0002) peak on Sapphire	10hz	2.596

Table S1: Table showing the d-spacing for the corresponding peak and laser frequency. The d-spacing was calculated using the XRD data and Bragg's law.

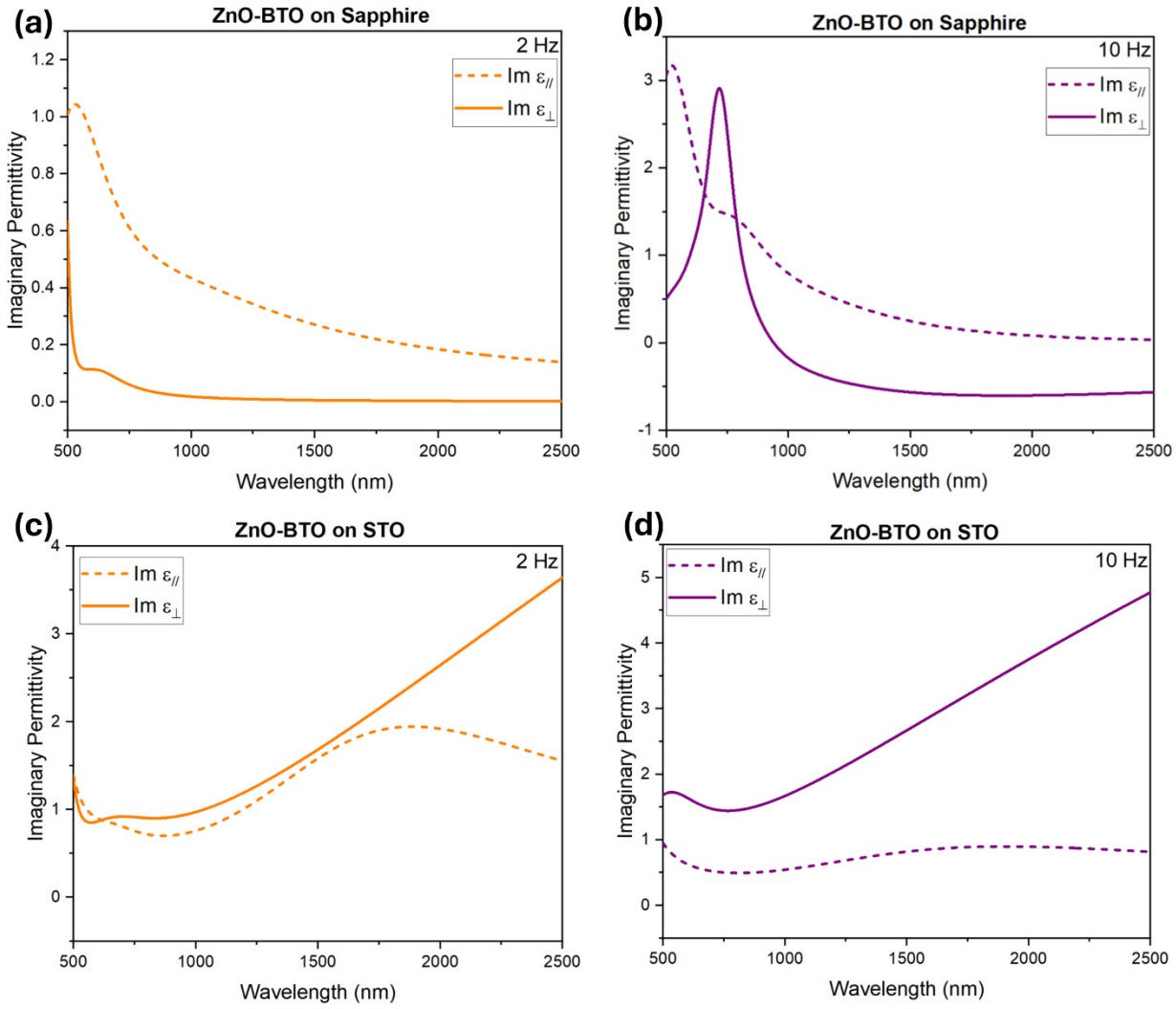

Figure S3: Imaginary permittivity of the ZnO-BTO VAN films. The dotted line is the in-plane imaginary permittivity while the solid line is the out of plane imaginary permittivity of (a) 2 Hz ZnO-BTO on Sapphire, (b) 10 Hz ZnO-BTO on Sapphire, (c) 2 Hz ZnO-BTO on STO, and (d) 10 Hz ZnO-BTO on STO.

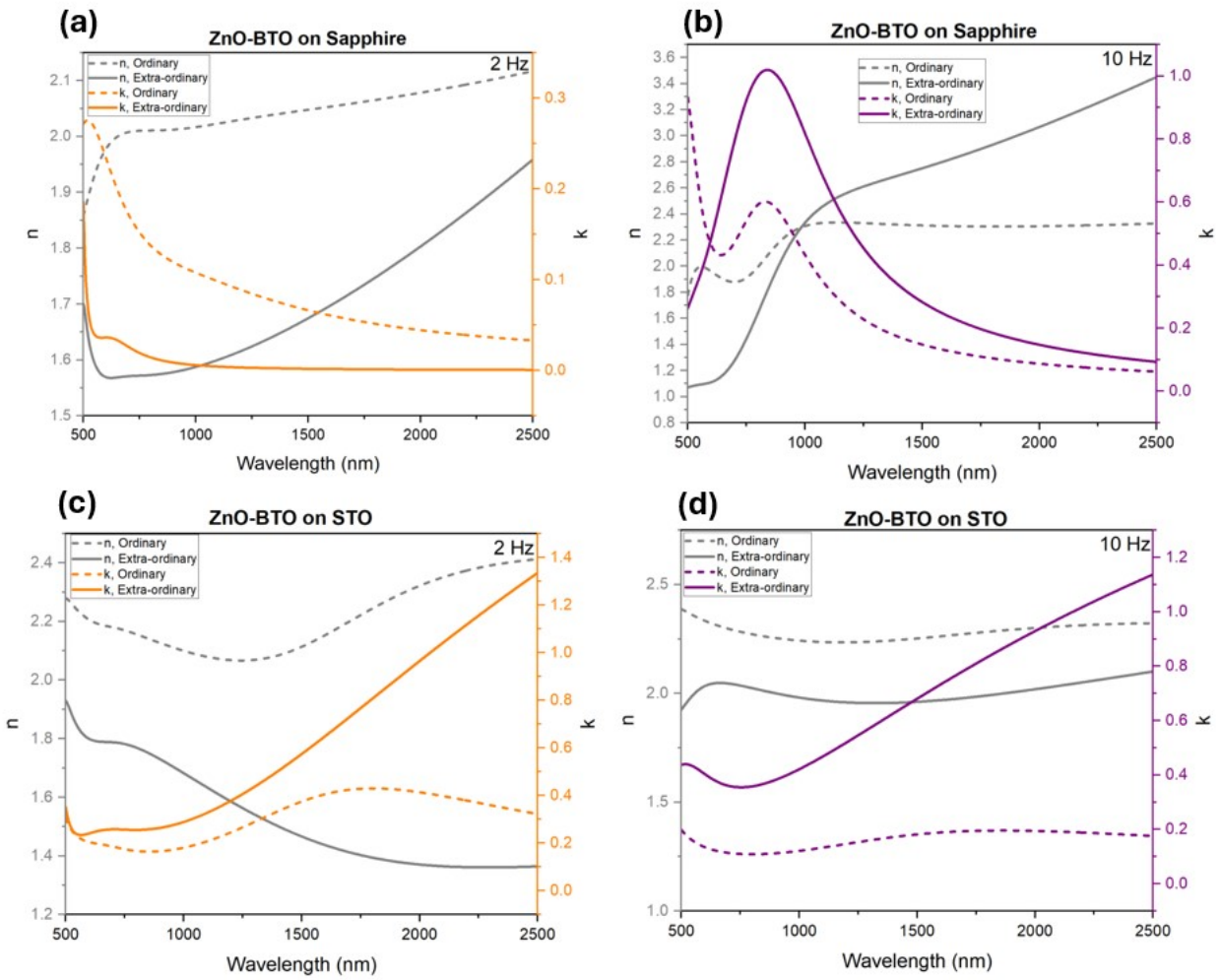

Figure S4: The refractive index (n) and extinction coefficient (k) of the films. n and k are shown for both in-plane(ordinary) and out of plane(extra-ordinary). The dotted line is the in-plane while the solid line is the out of plane. The plots show n and k of (a) 2 Hz ZnO-BTO on Sapphire, (b) 10 Hz ZnO-BTO on Sapphire, and (c) 2 Hz ZnO-BTO on STO, and (d) 10 Hz ZnO-BTO on STO.

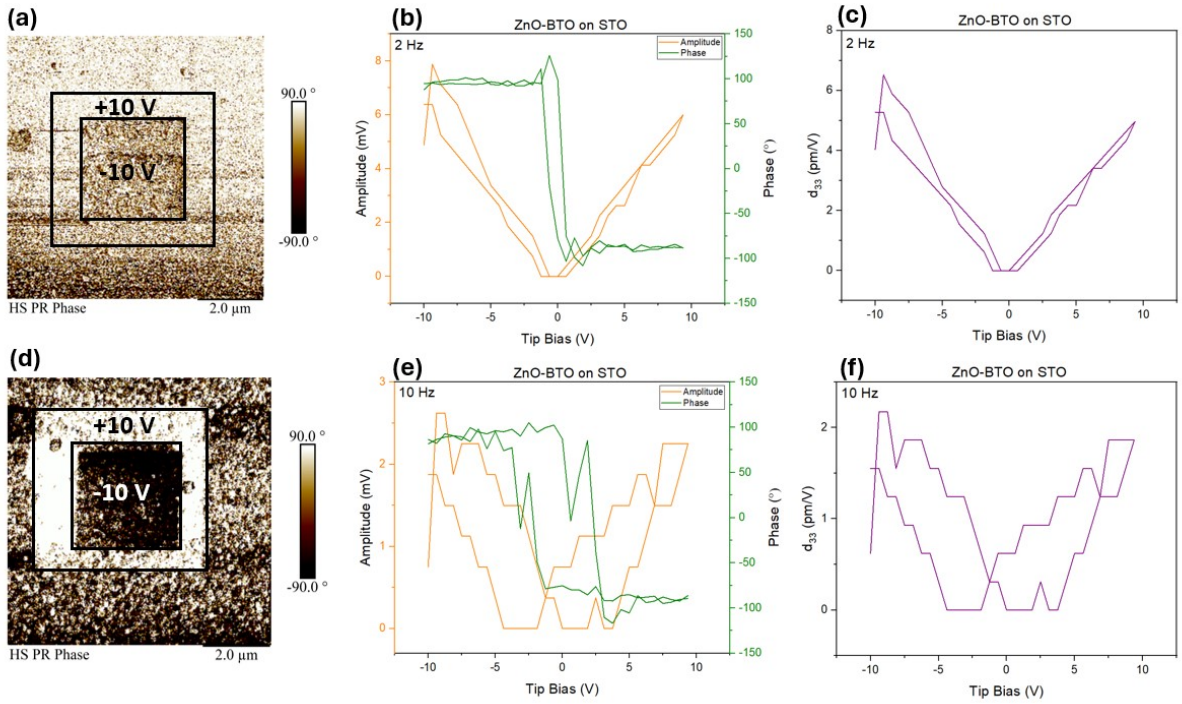

Figure S5: (a) PFM phase map, (b) phase and amplitude, and (c) d_{33} coefficient for the 2 Hz ZnO-BTO on STO. (d) PFM phase map, (e) phase and amplitude, and (f) d_{33} coefficient for the 10 Hz ZnO-BTO on STO.

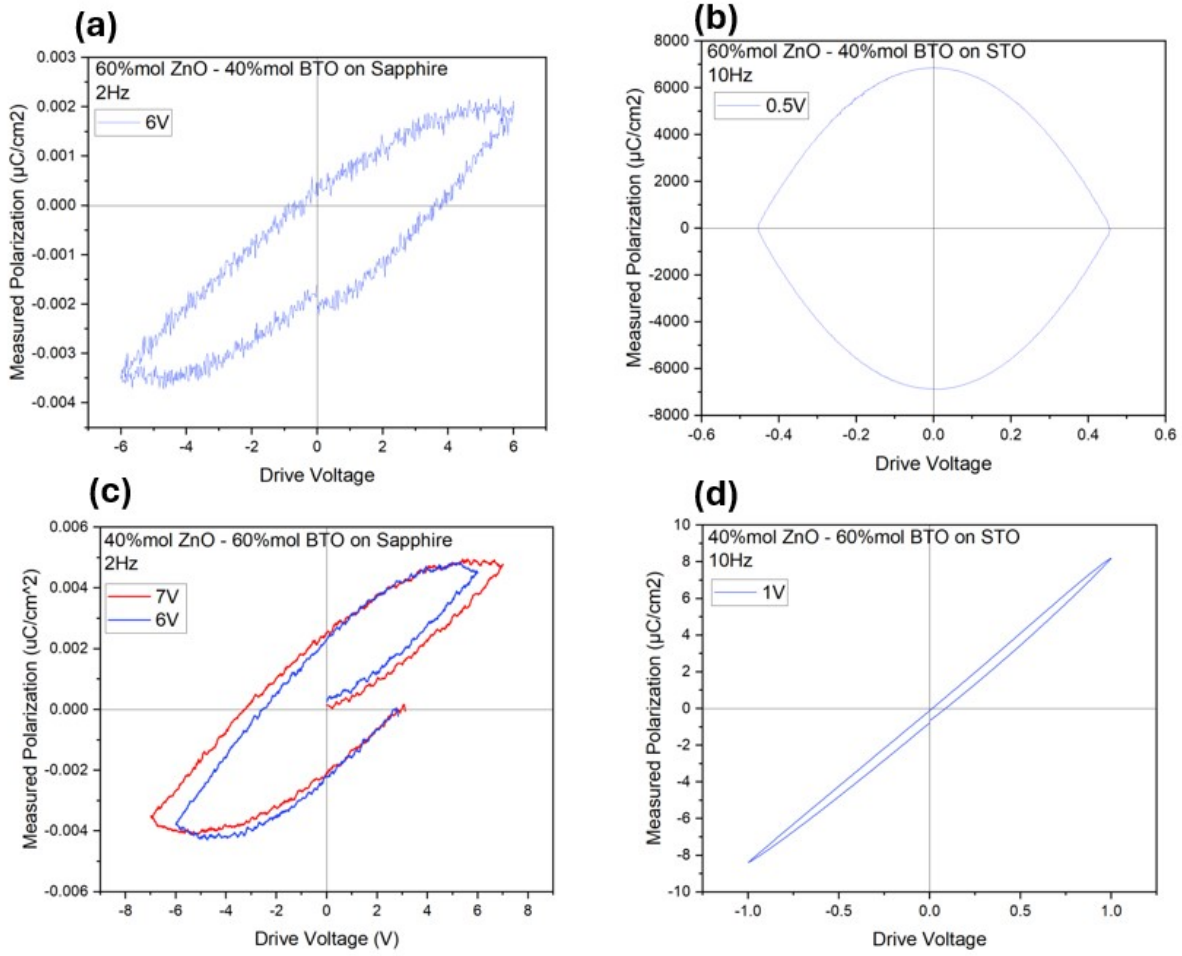

Figure S6: P-E loop of (a) 2 Hz 60% mol ZnO – 40% mol BTO on Sapphire, (b) 10 Hz 60% mol ZnO – 40% mol BTO on STO, (c) 2 Hz 40% mol ZnO – 60% mol BTO on Sapphire, and (d) 10 Hz 40% mol ZnO – 60% mol BTO on STO.

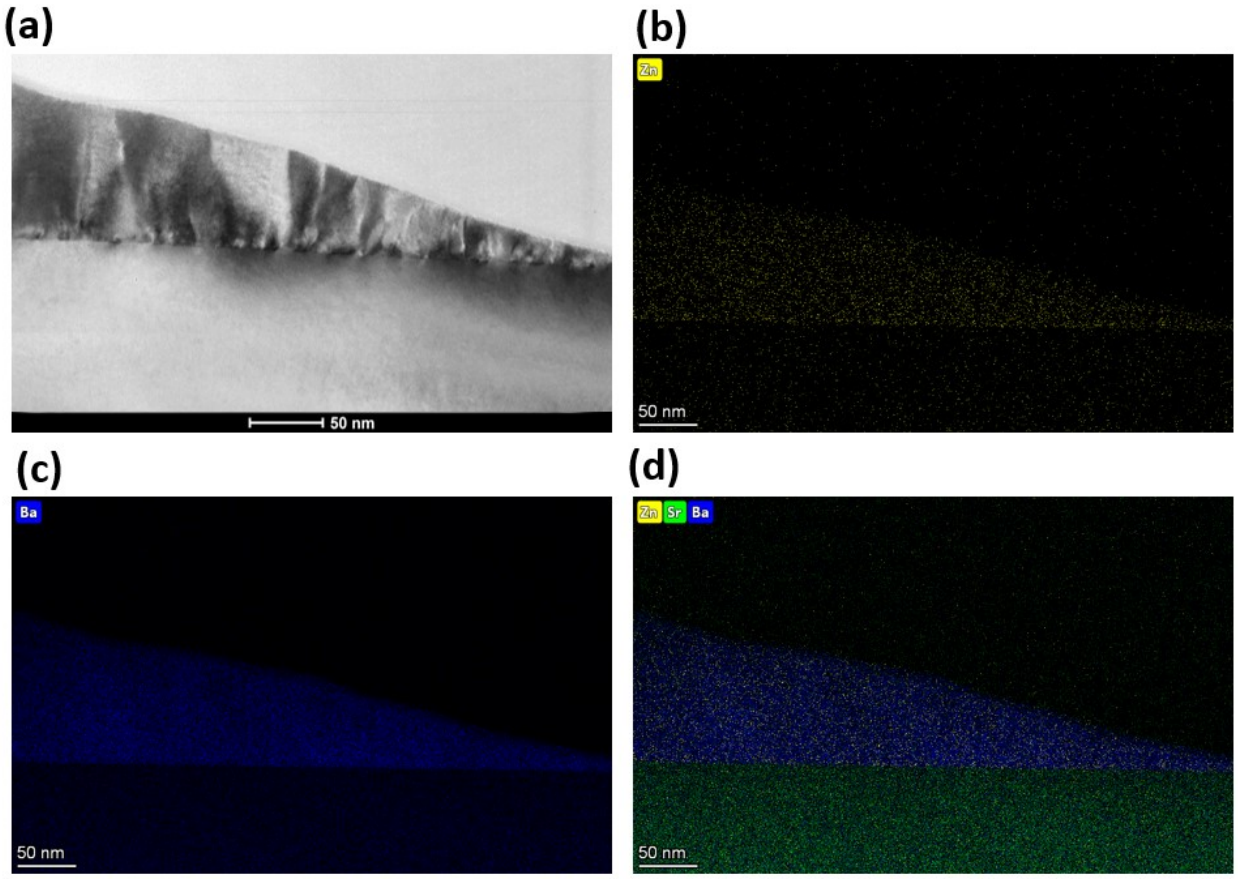

Figure S7: (a) TEM, (b) EDS of Zn, (c) Ba, and (d) combined Zn, Ba, Sr of 10 Hz 40%mol ZnO-60%mol BTO on STO. This growth is cleared homogenous and shows that this concentration of ZnO-BTO does not grow VAN.

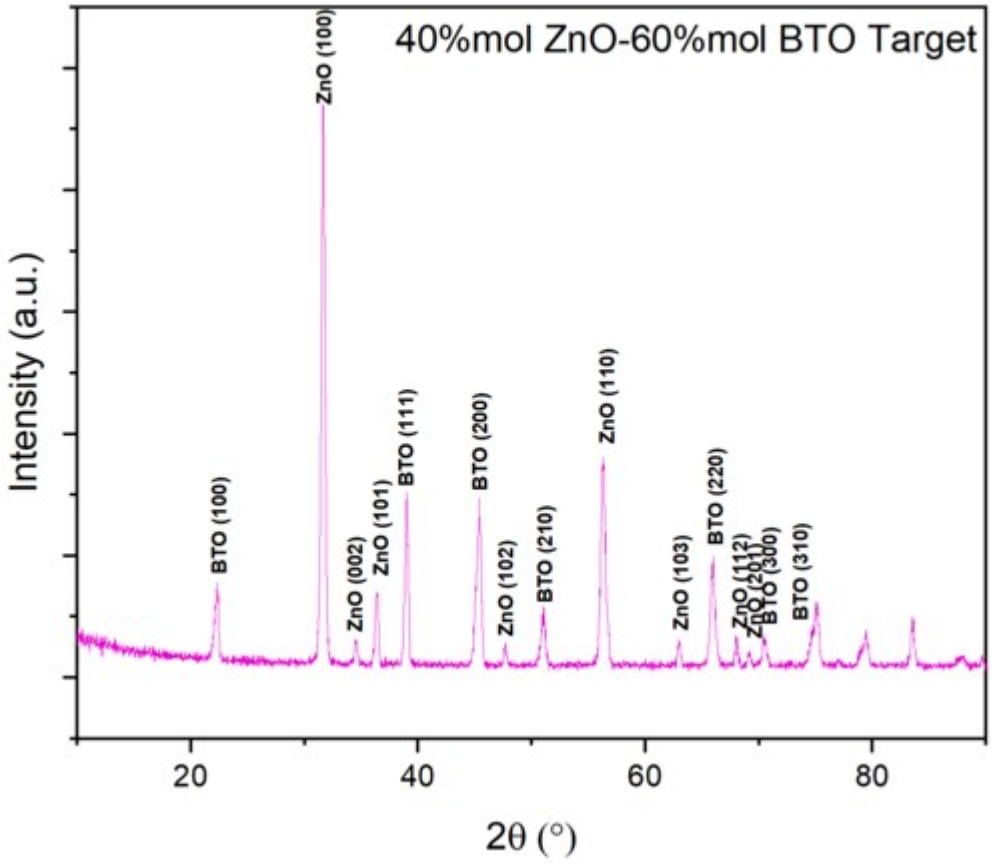

Figure S8: XRD $\theta - 2\theta$ scan of the 40%mol ZnO - 60%mol BTO nanocomposite target.

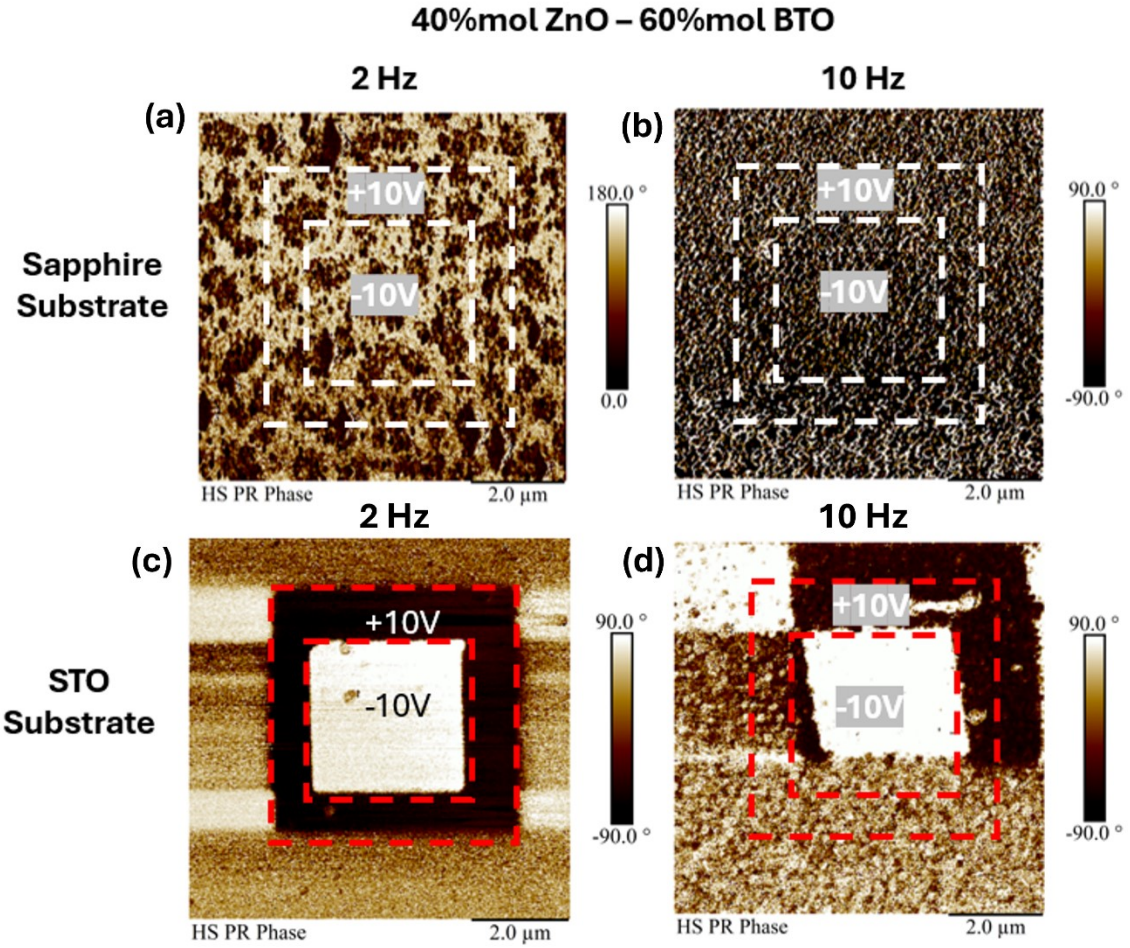

Figure S9: PFM phase maps of 40%mol ZnO – 60%mol BTO thin films. Phase map of (a) 2 Hz and (b) 10 Hz 40%mol ZnO – 60%mol BTO on Sapphire. Phase map of (c) 2 Hz and (d) 10 Hz 40%mol ZnO – 60%mol BTO on STO.

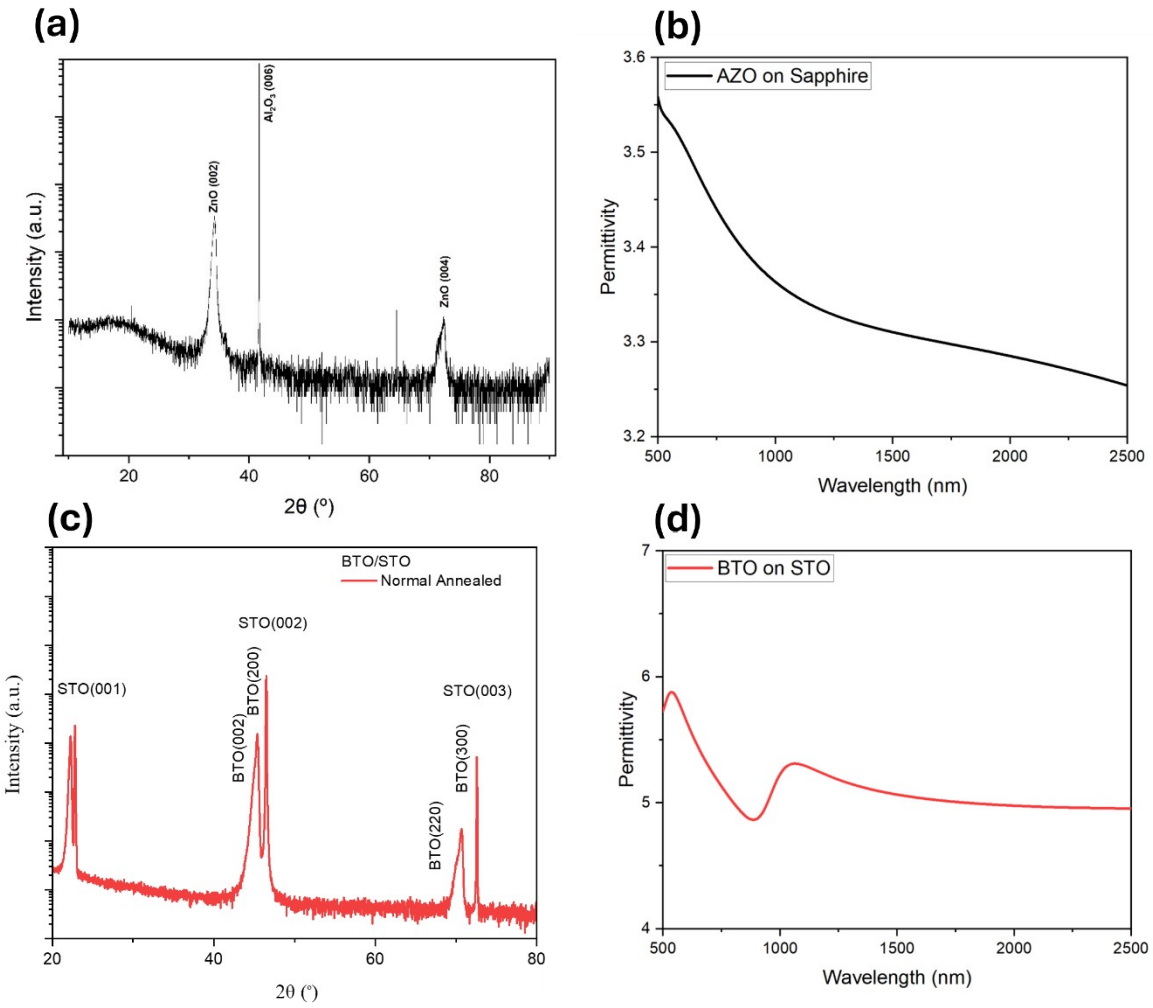

Figure S10: (a) XRD of Al-doped ZnO (AZO) on Sapphire, (b) permittivity data of AZO on Sapphire, (c) XRD of BTO on STO, and (d) permittivity data of BTO on STO.