Supplementary Material

Highly UV-responsive indium-free Zn-Sn-Al-O phototransistor for optoelectronic artificial synapses

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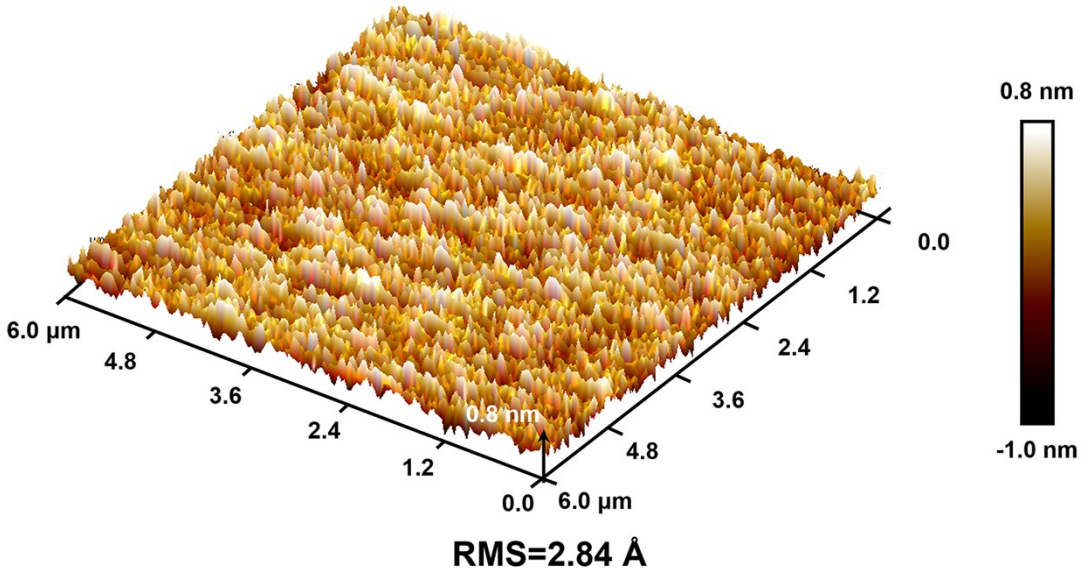

Fig. S1. AFM image of ZTAO films on SiO_2/Si substrate.

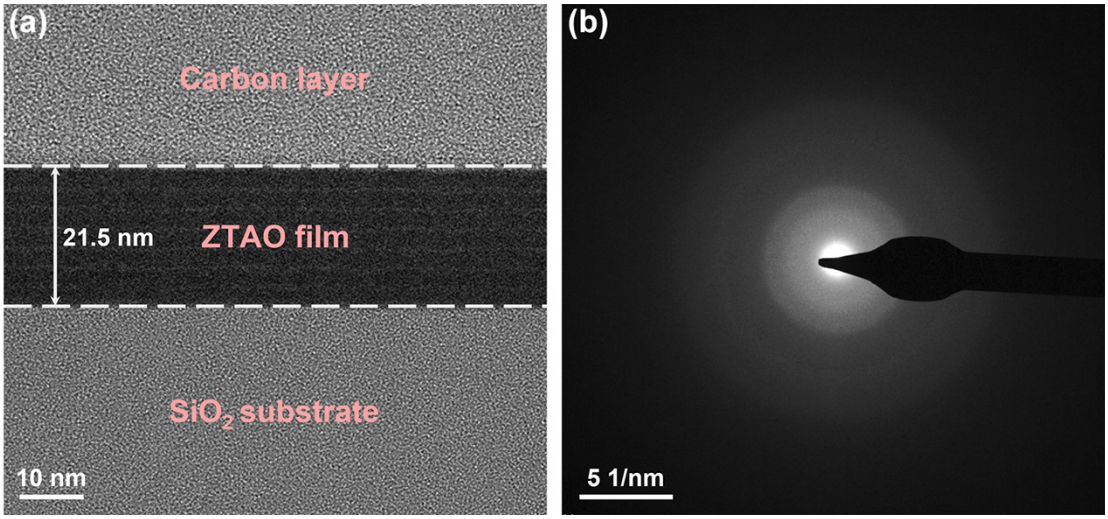

Fig. S2. (a) Cross-sectional TEM image of the ZTAO films on SiO_2/Si substrate; (b) selected area electron diffraction (SAED) pattern of ZTAO films.

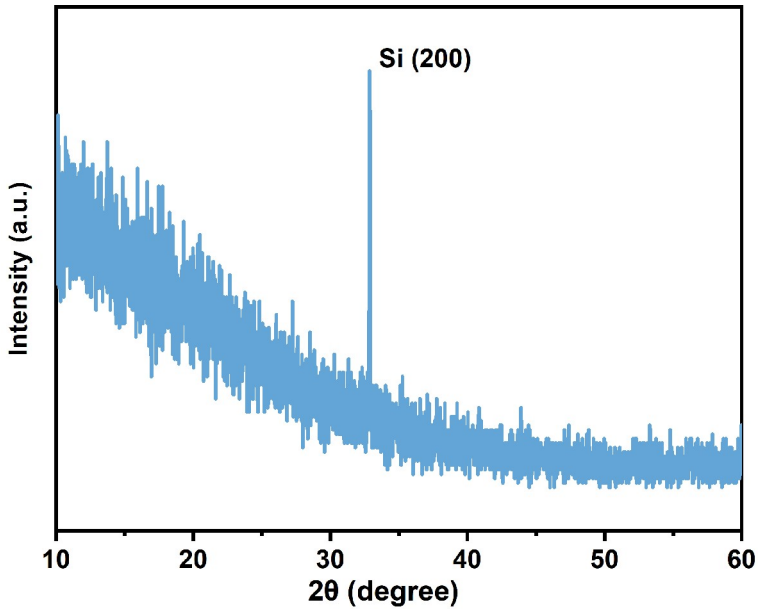

Fig. S3. X-ray diffraction pattern of ZTAO films on Si/SiO_2 substrate.

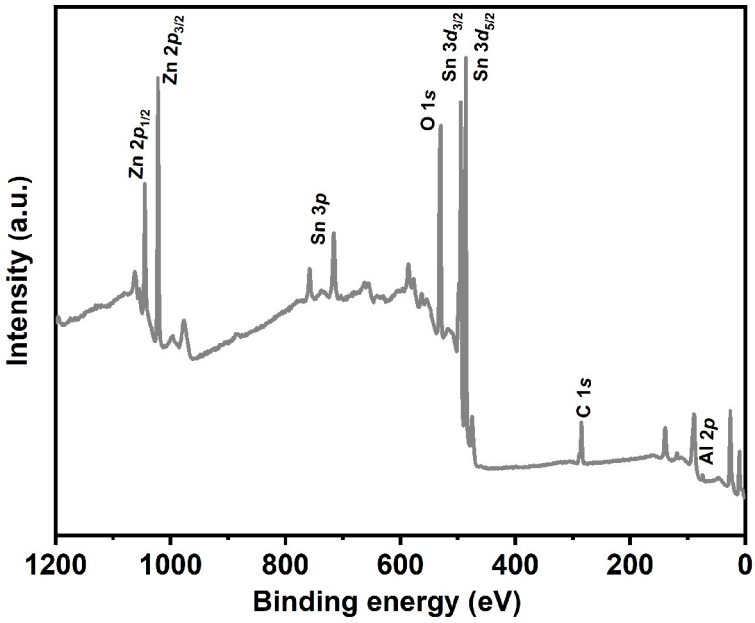

Fig. S4. XPS full spectrum of ZTAO thin films.

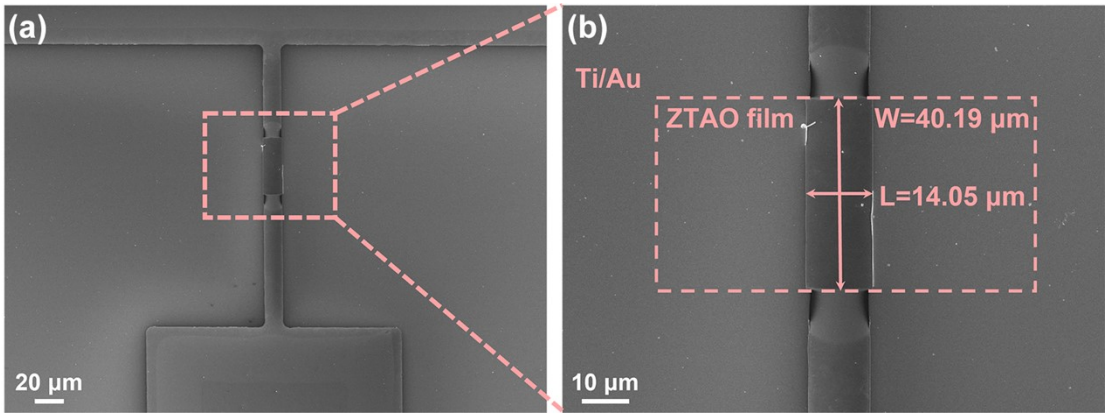

Fig. S5. (a) Top-view SEM image of the ZTAO phototransistor; (b) magnified SEM image of the channel region.

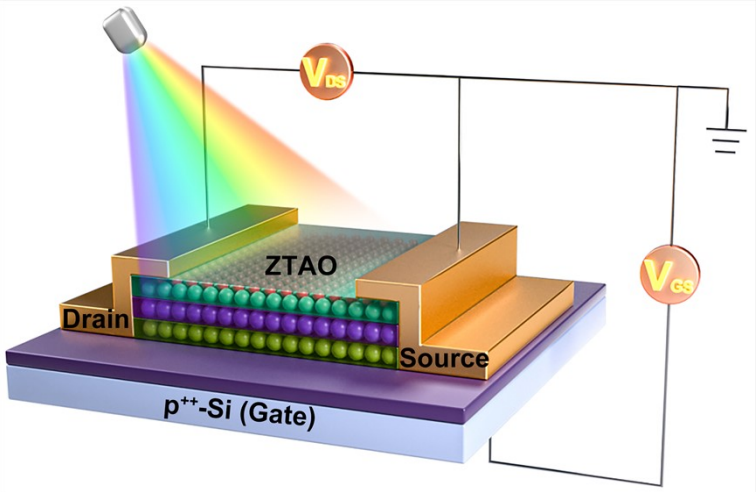

Fig. S6. Schematic illustration of the optoelectronic performance measurement setup for the ZTAO phototransistors.

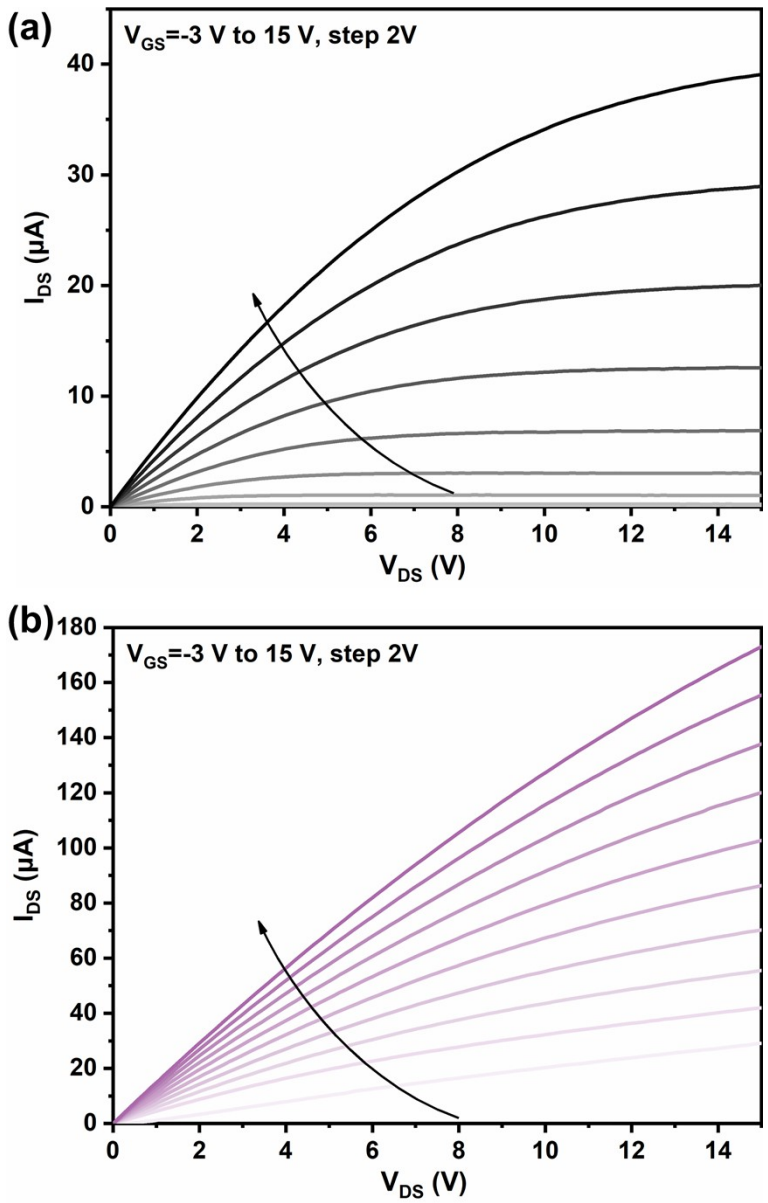

Fig. S7. Output characteristics of the ZTAO phototransistors: (a) under dark conditions; (b) under illumination (310 nm, 5 mW cm^{-2}).

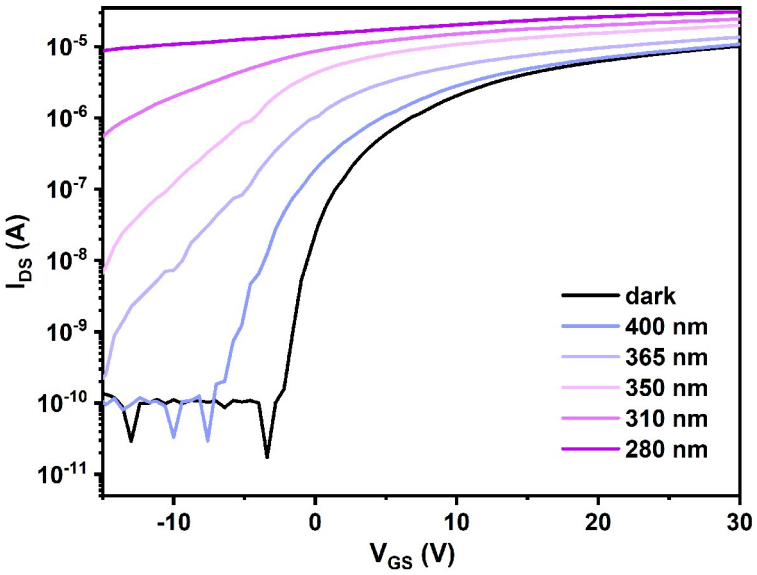

Fig. S8. Transfer characteristics of the ZTAO phototransistor measured under dark conditions and illumination at wavelengths of 280 nm, 310 nm, 350 nm, 365 nm, and 400 nm (V_{DS}=1 V, light intensity=5 mW cm^{-2}).

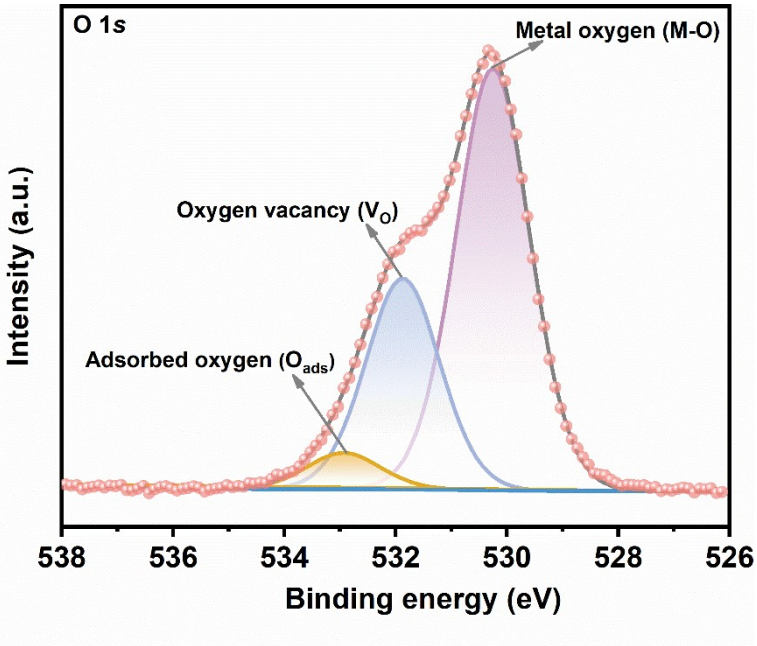

Fig. S9. Deconvoluted O 1*s* XPS spectrum of ZTAO films, showing the fitted components corresponding to different oxygen bonding states.

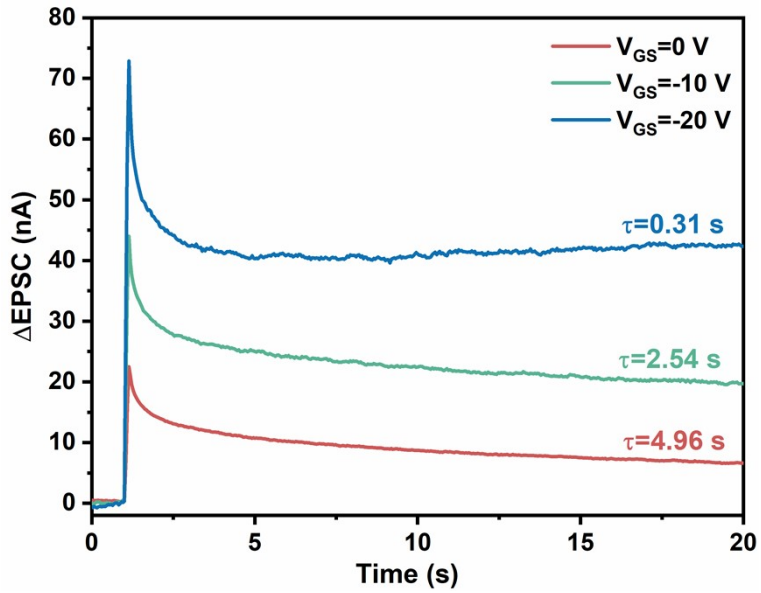

Fig. S10. Excitatory postsynaptic current responses of the ZTAO optoelectronic artificial synapses under single-pulse optical stimulation with negative gate bias (V_{DS}=0.1 V, 5 mW cm^{-2}, duration=100 ms, 310 nm).

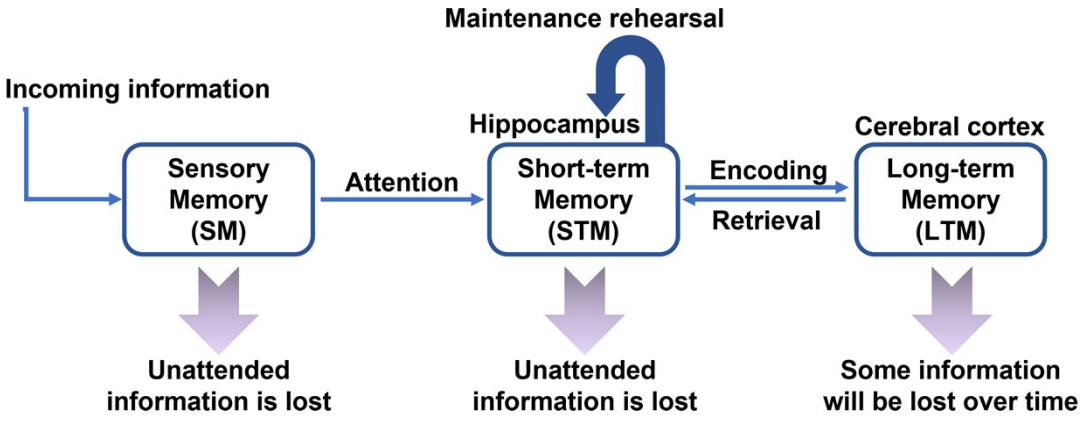

Fig. S11. Schematic illustration depicting the transition from short-term plasticity to long-term plasticity.

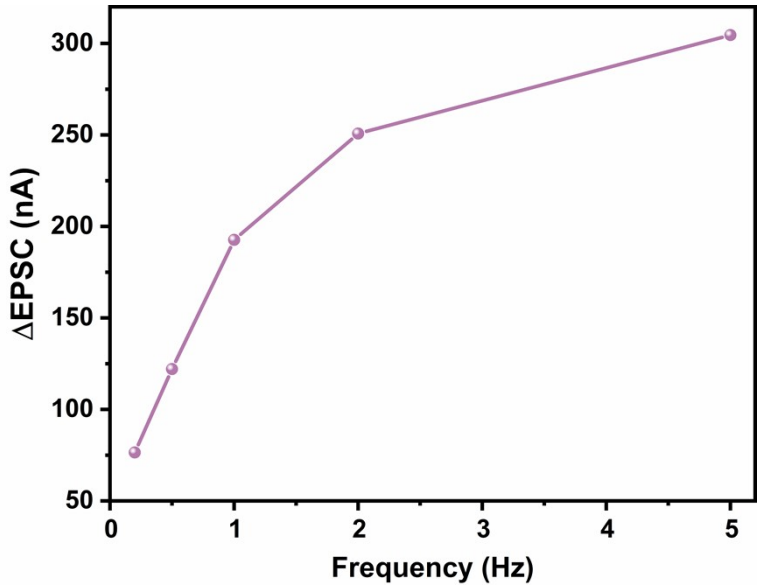

Fig. S12. Relationship between ΔEPSC and pulse frequency in ZTAO optoelectronic synapses.

Table S1. Comparison of the optoelectronic performance of AOS-based phototransistor.

Structure	Fabrication methods	Condition	R (A W^{-1})	D^* (Jones)	$PDCR$ (%)	Ref.
InAlZnO	Sputtering	250 nm	6.18	—	~10^7	[1]
InSnZnO	Sputtering	367 nm	480	3.20×10^{12}	~10^9	[2]
SiInZnO	Sputtering	350 nm	4930	5.47×10^{15}	4.87×10^6	[3]
H: InGaZnO	Sputtering	400 nm	1.49×10^4	4.00×10^{13}	~10^6	[4]
InGaZnO	Sputtering	365 nm	126.2	6.80×10^{13}	6.20×10^8	[5]
GaO_x	Sputtering	254 nm	4100	2.50×10^{13}	~10^4	[6]
Ga_2O_3	Sputtering	254 nm	~10^4	~10^{15}	~10^9	[7]
ZnO/Ga_2O_3	PLD	254 nm	178	6.80×10^{14}	1.70×10^6	[8]
ZnO/SnO_2	Spin-coating	365 nm	82.8	7.79×10^{13}	~10^{10}	[9]
$IGZO/SnO_x$	Sputtering	320 nm	984	3.30×10^{14}	~10^7	[10]
ZnSnAlO	**PEALD**	**310 nm**	**658**	**6.09×10^{13}**	**1.22×10^8**	This work

References:

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