

Supplementary Data of MnAl₂O₄·ZnAl₂O₄:

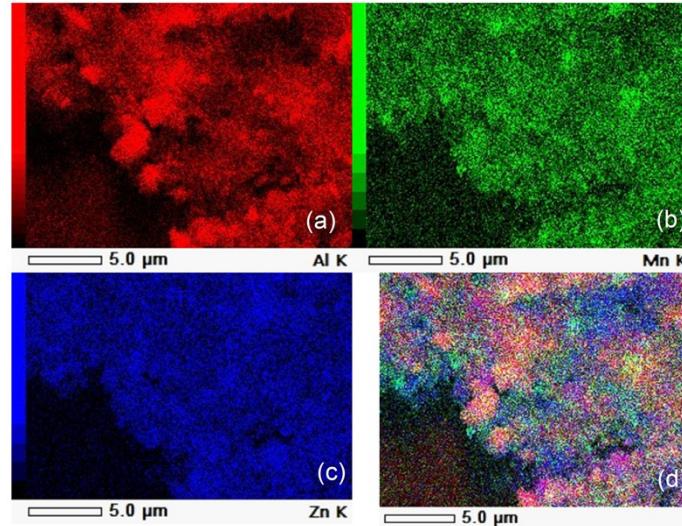


Figure S1: SEM-EDS mapping of the MnAl₂O₄·ZnAl₂O₄ nanomaterial film surface

Table S1: EDS Analysis data sheet of MnAl₂O₄·ZnAl₂O₄ nanomaterial

Element	(keV)	Mass (%)	Sigma	Atom (%)
O K	0.525	22.75	0.08	47.4
Al K	1.486	16.45	0.07	20.32
Mn K	5.894	13.07	0.1	7.93
Zn K	8.63	47.73	0.33	24.34
Total		100		100

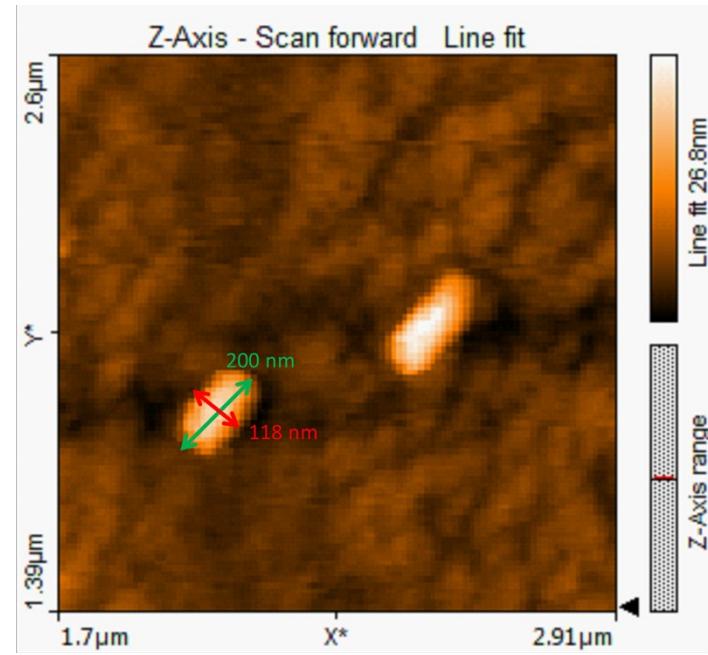


Figure S2: Tapping mode AFM of $\text{MnAl}_2\text{O}_4 \cdot \text{ZnAl}_2\text{O}_4$ nanomaterial in glass surface

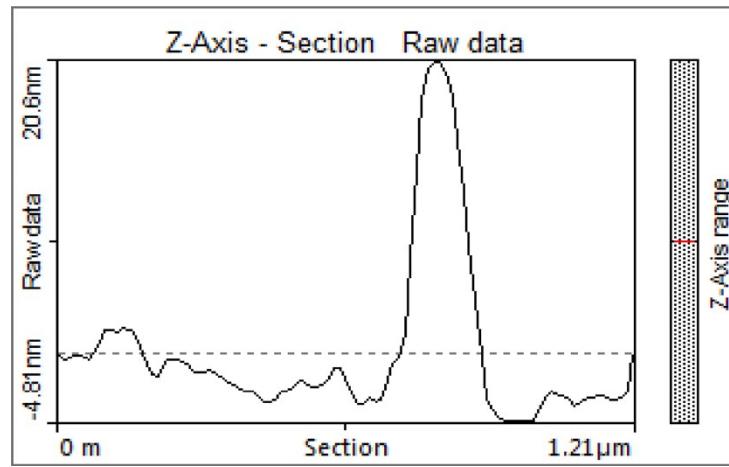


Figure S3: Height profile of the $\text{MnAl}_2\text{O}_4 \cdot \text{ZnAl}_2\text{O}_4$ nanomaterial film surface

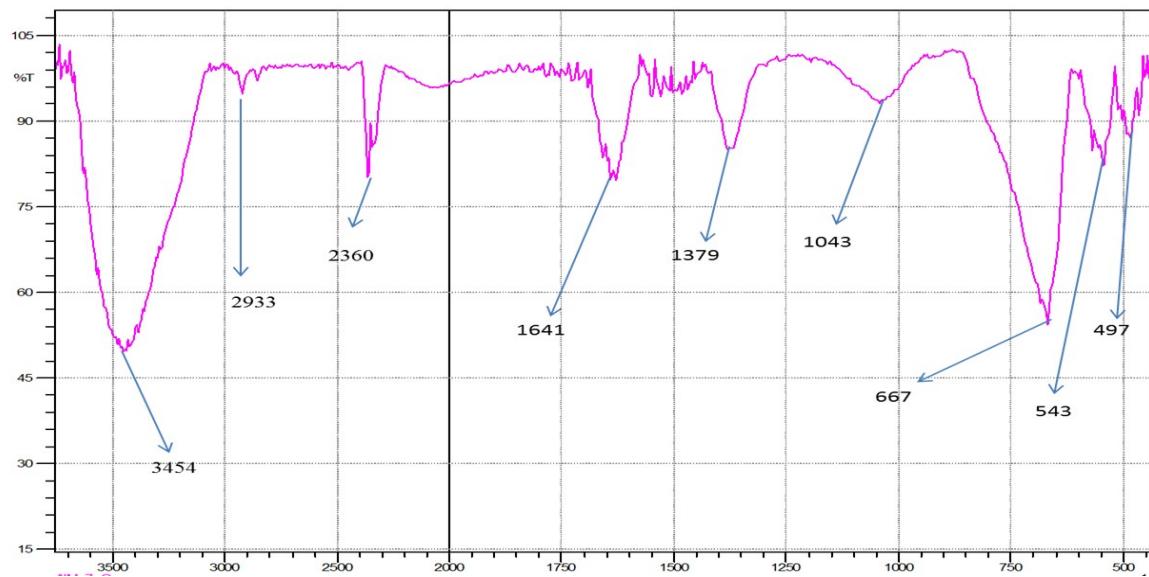


Figure S4: FTIR spectra of MnAl₂O₄·ZnAl₂O₄ nanoparticles

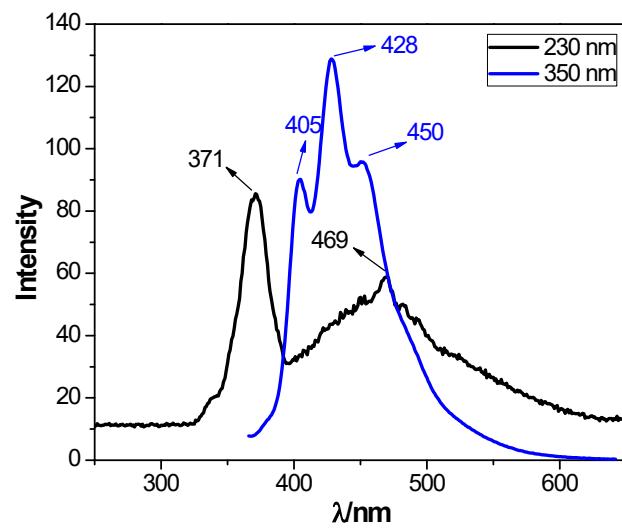


Figure S5: PL spectra of MnAl₂O₄·ZnAl₂O₄ nanomaterial at differing excitation energy

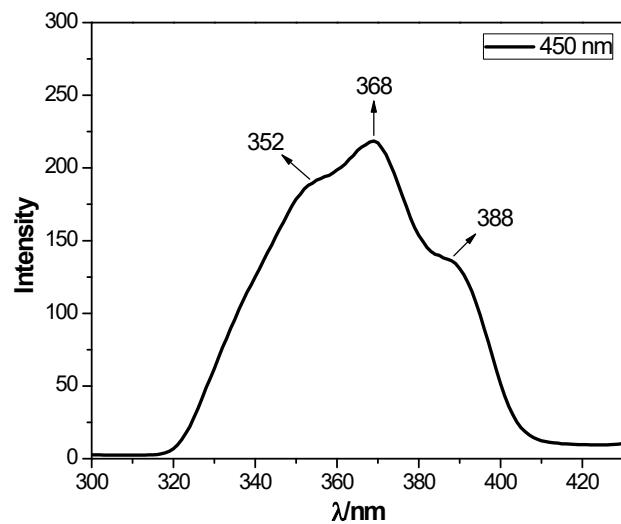


Figure S6: PLE spectra of $\text{MnAl}_2\text{O}_4 \cdot \text{ZnAl}_2\text{O}_4$ nanomaterial

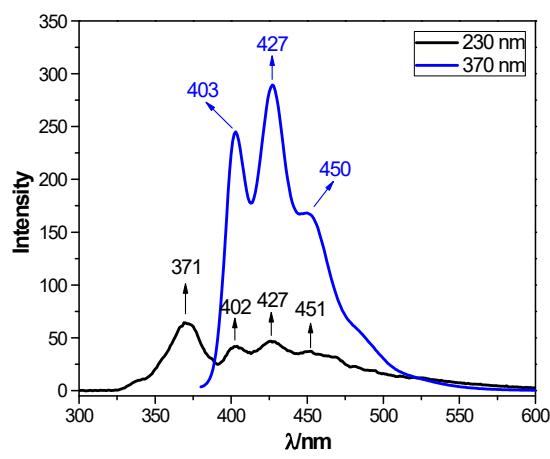


Figure S7: PL spectra of MnAl_2O_4 nanomaterial at differing excitation energy

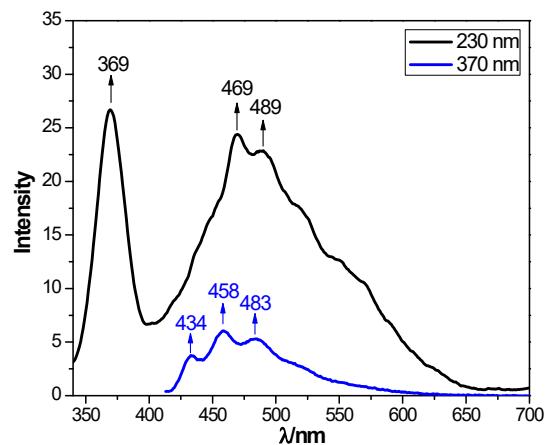


Figure S8: PL spectra of MnO \cdot ZnO nanomaterial at differing excitation energy

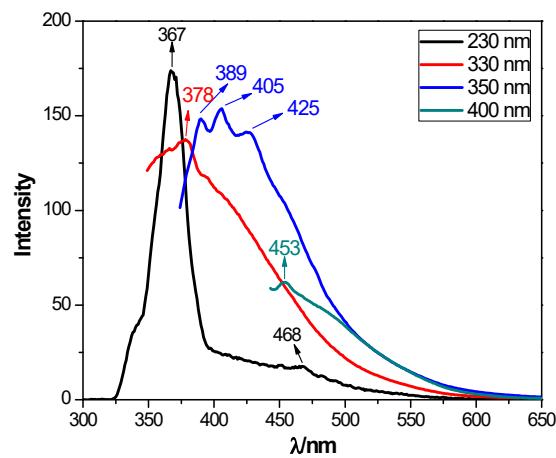


Figure S9: PL spectra of ZnAl₂O₄ nanomaterial at differing excitation energy

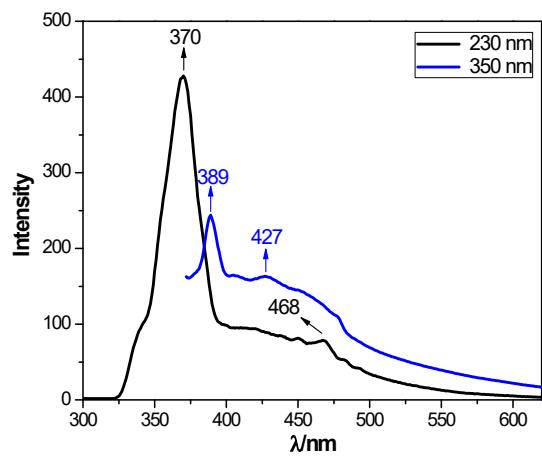


Figure S10: PL spectra of Al₂O₃ nanomaterial at differing excitation energy

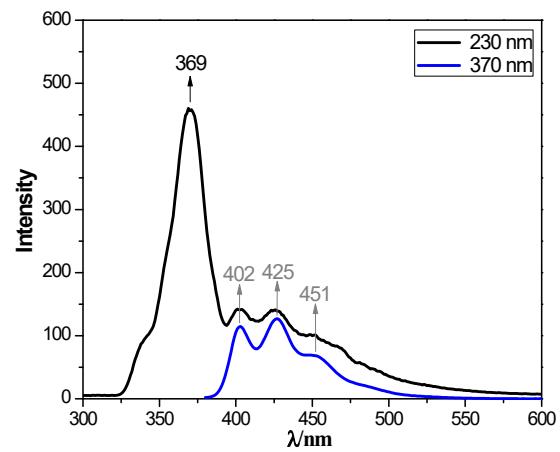


Figure S11: PL spectra of MnO nanomaterial at differing excitation energy

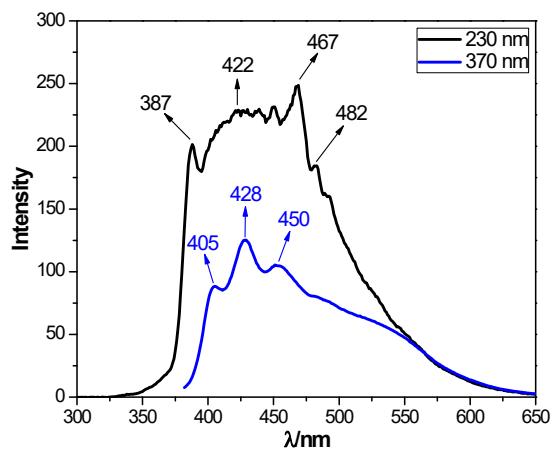


Figure S12: PL spectra of ZnO nanomaterial at differing excitation energy

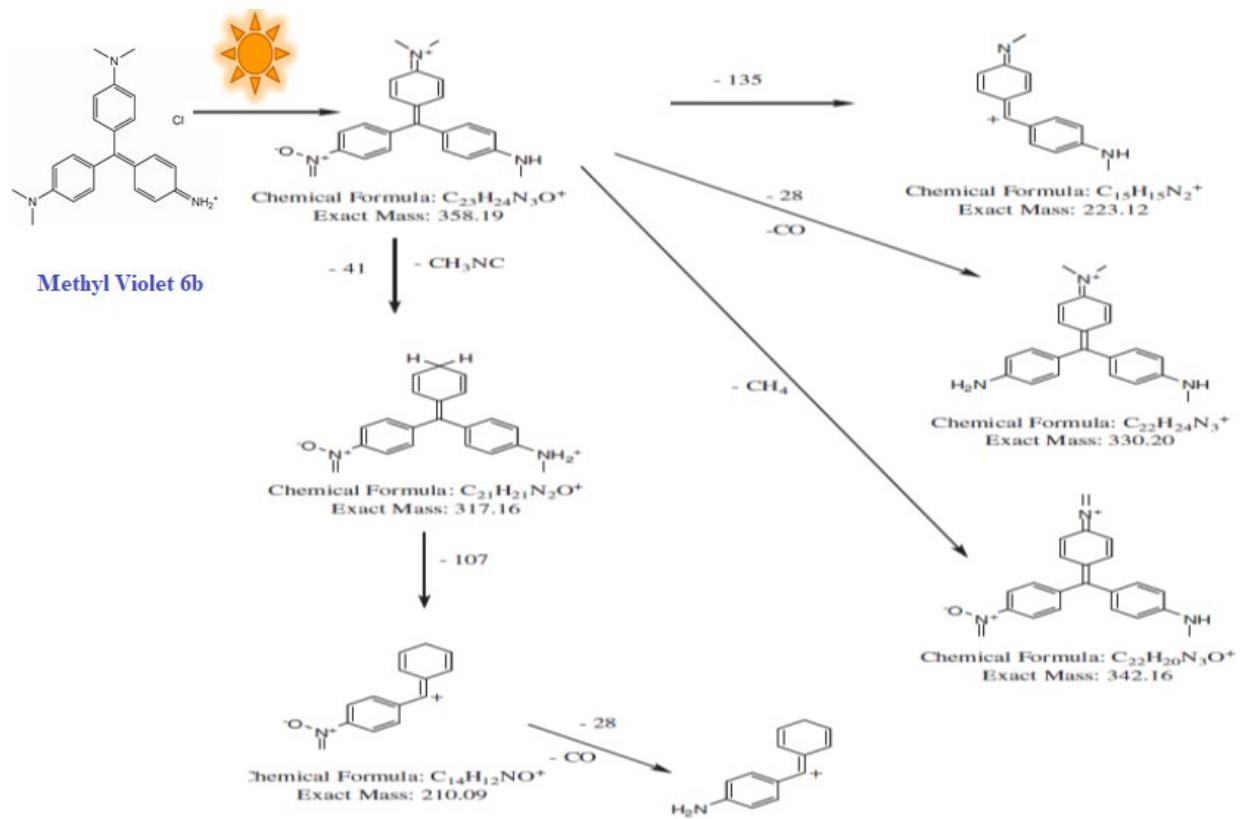


Figure S13. Methyl violet 6b (MV) dye degradation schemes by mass spectrometry. (Adapted in modified form with permission from Favaro G, Confortin D, Pastore P and Brustolon M,

Application of LC-MS and LC-MS-MS to the analysis of photo-decomposed crystal violet in the investigation of cultural heritage materials aging, J. Mass Spectrom. 2012, 47, 1660–1670.)

Table S2: PL and PLE spectra data accumulation of synthesized nanomaterial

Name of the sample	Excitation Wavelength (nm)	Peaks Wavelength (nm)
$\text{MnAl}_2\text{O}_4 \cdot \text{ZnAl}_2\text{O}_4$	230	371 and 469
	350	405, 428 and 450
	PLE at 450	352, 368 and 388
MnAl_2O_4	230	371, 402, 427 and 451
	350	403, 427 and 450
$\text{MnO} \cdot \text{ZnO}$	230	369, 469 and 489
	350	434, 458 and 483
ZnAl_2O_4	230	367 and 468
	330	378
	350	389, 405 and 426
	400	453
Al_2O_3	230	370 and 468
	350	389 and 427
MnO	230	369, 402, 425 and 451
	350	402, 425 and 451
ZnO	230	387, 422, 467 and 482
	350	405, 428 and 450