Structural and Photoprotective Characteristics of Zn-Ti, Zn-Al, and Mg-Al Layered Double Hydroxides—A Comparative Study

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Supplementary information

Table S1: Relative amounts of contents for oil/water formulations.

		2 wt% Formulation
		Amount (g)
Aqua Phase	Water	54.8
	Rheology Modifier	25
	Carbomer	0.2
	NaOH	0.5
Oil Phase	Oil	10
	LDH*	2
	Alracel	3
	C/S Alcohol	4
	Preservative	0.5

LDH* - in the case of the 2 wt% Zn-Al formulation, 2g of Zn-Al LDH was used instead of Zn-Ti LDH

Both the oil phase and aqueous phase containing Zn-Ti LDH (2 wt%) were heated to 70 °C. After both phases reached the desired temperature, the oil phase was combined into the water phase and mixed for

5 minutes with a high shear silverson homogenizer. The neutralizer was then added, and the whole mixture was then mixed for another 5 minutes with the same homogenizer at 3000 rpm. The mixture was cooled to 40 °C and a preservative was added to obtain the LDH based emulsion. The pH of the final formulation was adjusted to 5.6.

XRD

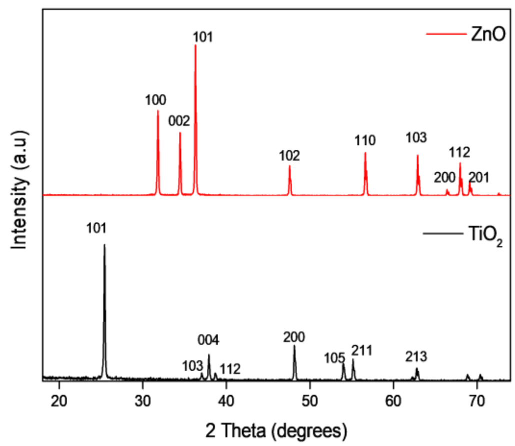

Figure S1. XRD spectra of TiO_2 and ZnO.

SEM

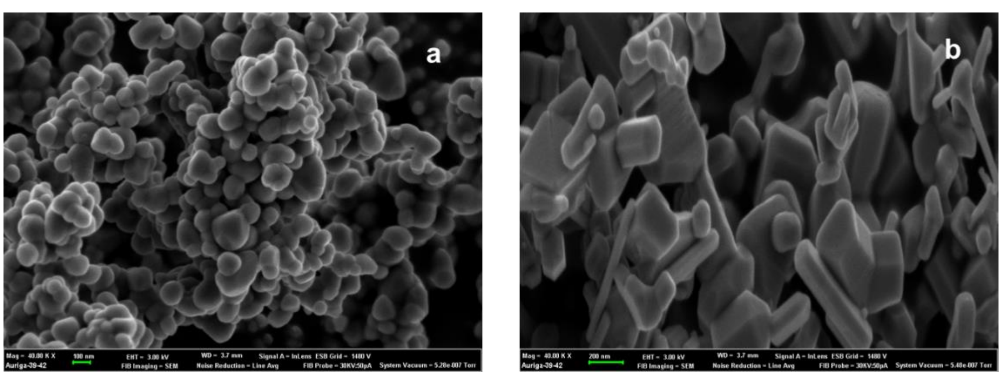

Figure S2. SEM images of a) TiO_2 and b) ZnO.

BET

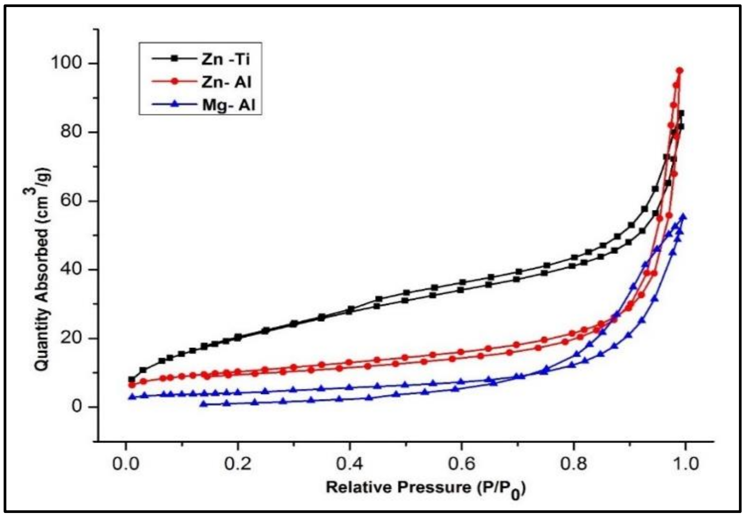

Figure S3. N_2 - adsorption isotherms for LDHs synthesized with different metal cations.

The shapes of the Zn-Al and Mg-Al adsorption isotherms (Figure S3) were similar, with minimal amounts of nitrogen adsorbed at lower relative pressures, and a higher amount only being adsorbed at higher relative pressures. Zn-Al and Mg-Al LDH displayed a typical isotherm Type IV, which is indicative of mesoporous materials. A characteristic feature of Type IV isotherm is its H_1 hysteresis loop which is fairly narrow, and the adsorption and desorption branches are nearly parallel and are usually explained by the presence of agglomerates. The substitution of Ti^{4+} within the layers changed the isotherm of Type II for Zn-TI LDH with an H_3 hysteresis loop usually associated with the presence of plate-like particles with very narrow slit-shaped pores. The Zn-Ti LDH isotherm, in comparison, shows a higher quantity of adsorbed nitrogen at lower relative pressure, accompanied by a steeper increase at higher relative pressures associated with a higher degree of interparticle porosity.

K-M Graphs

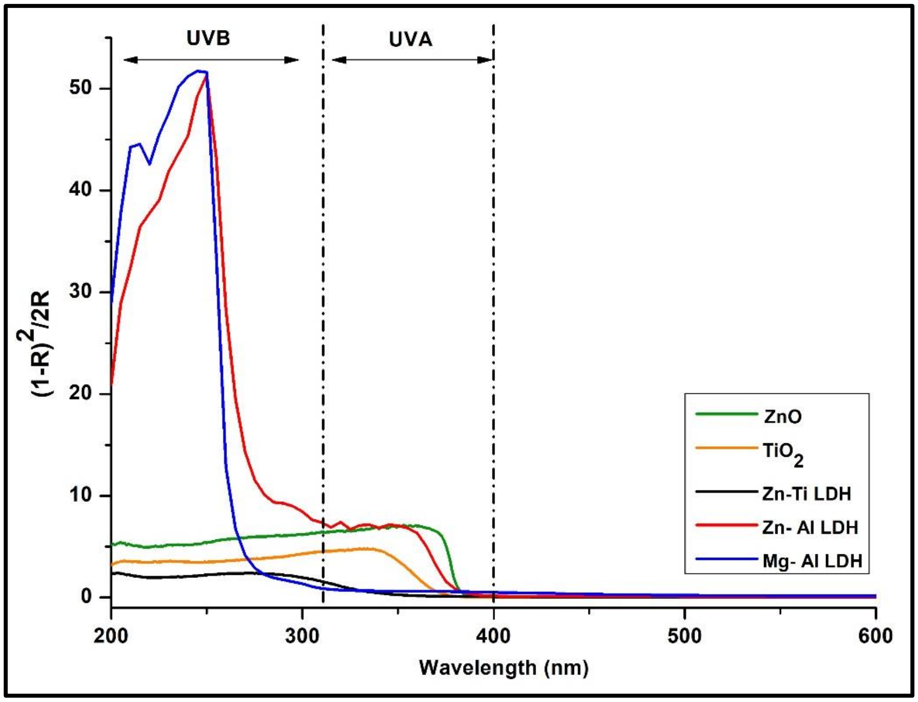

Figure S4. Kubelka-Munk plot of different LDH and references (ZnO and TiO_2).

Band Gap

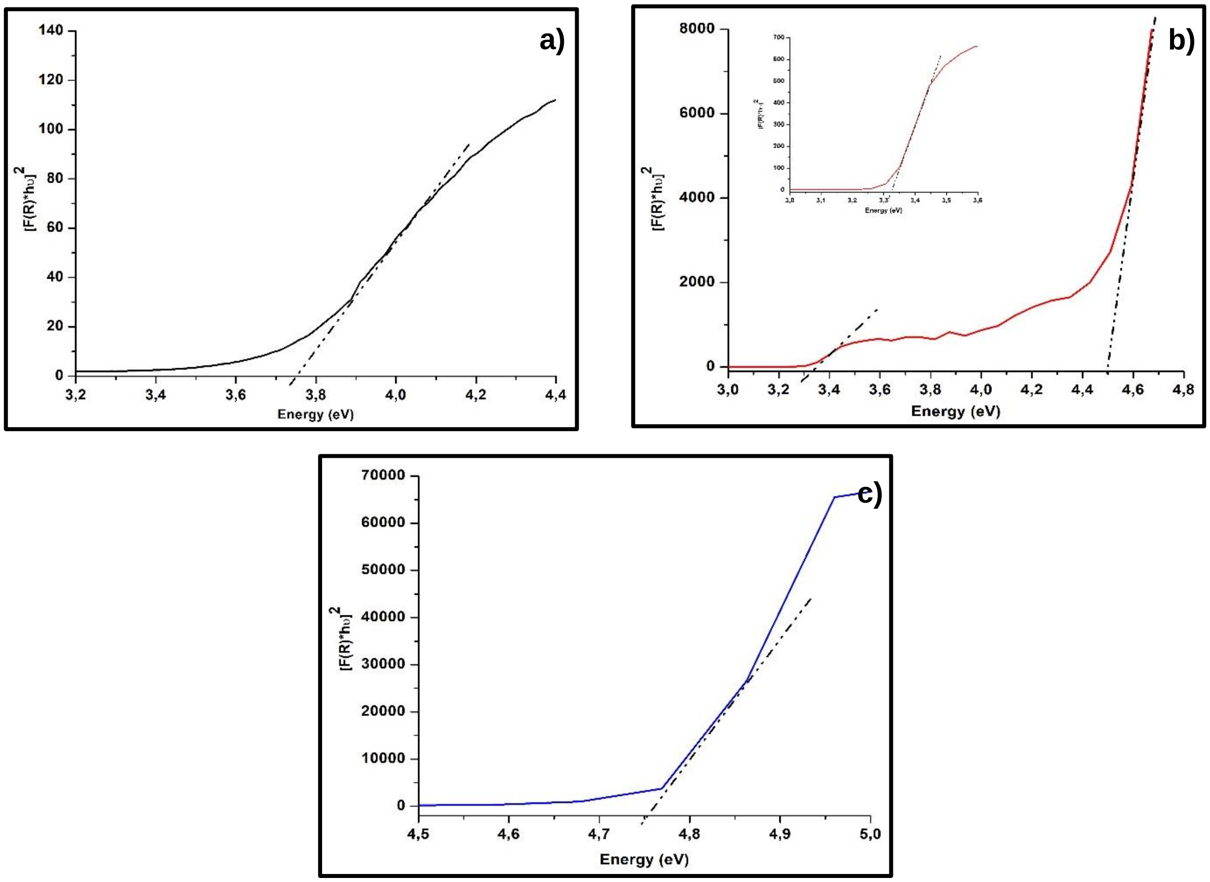

Figure S5. Tauc plots indicating the band Gap of a) Zn-Ti LDH, b) Zn-Al LDH and c) Mg-Al LDH.