Zinc Oxide Nonofibers For Photocatalytic Activity

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Motivation

Photocatalysis → Low Cost Depollution Technique → Wastewater Air And Soils

Zinc Oxide thin films ZnO → Simple deposition route sol-gel dip coating

Sol concentration varied from 0.2 M to 0.5 M → Nanostructured material → High photocatalytic activity

Experiment

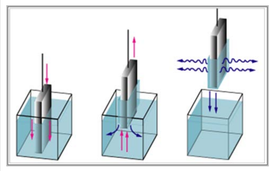


Fig.1: Sol-gel dip coating deposition Method

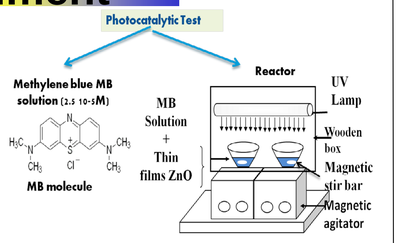


Fig .2: Experimental set up for the photocatalytic test with methylene blue MB

Results and Discussions

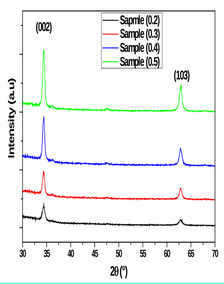


Fig.3 XRD patterns of ZnO layers

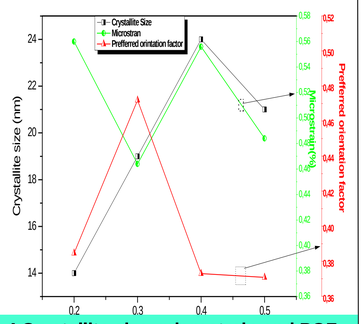


Fig. 4 Crystallite size, microstrain and POF parameters of ZnO versus sol concentration.

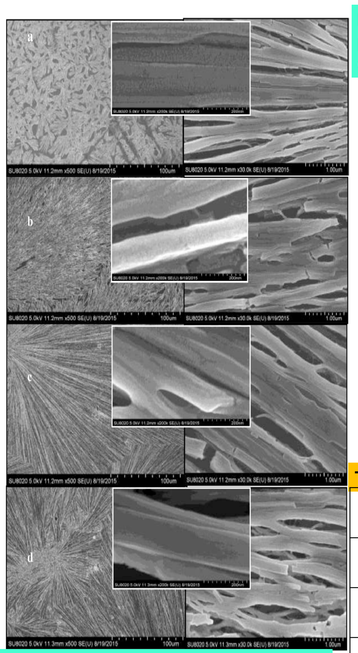
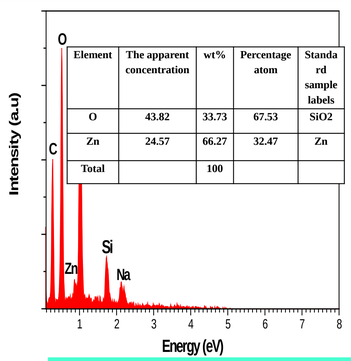


Fig. 5 SEM images of ZnO films deposited from sol concentration: a) 0.2M b) 0.3M; c) 0.4M and d) 0.5M.



Element	The apparent concentration	wt%	Percentage atom	Standard sample labels
O	43.82	33.73	67.53	SiO2
Zn	24.57	66.27	32.47	Zn
Total		100		

Fig. 6 ZnO thin films EDS analysis

Table1. Structural parameters of ZnO thin films

Sample	Lattice Parameters (Å)		Refinements factors				
			Rwp(%)	Rp(%)	Re(%)	S	• ²
0 .2	3.252(1)	5.219(1)	9.83	7.79	6.51	1.51	2.27
0.3	3.246(2)	5.205(3)	10.92	7.73	6.48	1.68	2.83
0.4	3.245(2)	5.205(2)	9.59	6.20	6.06	1.58	2.50
0.5	3.244(1)	5.200(2)	13.48	8.01	6.39	2.11	4.44

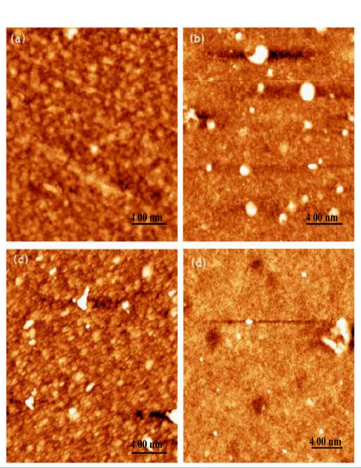


Fig. 7 ZnO AFM scans for sol concentrations : a) 0.2M, b) 0.3M, c) 0.4M, and d) 0.5M

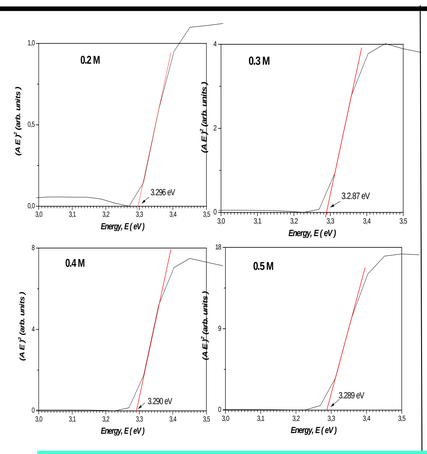
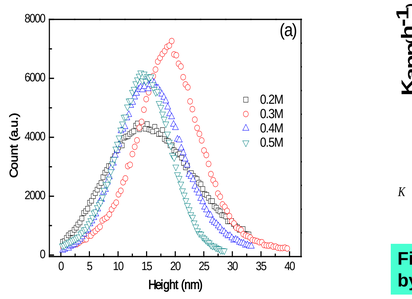


Fig. 10 Direct optical band gaps for ZnO films



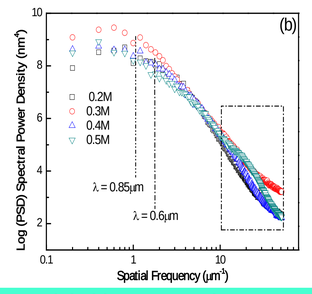


Fig. 8 Height histogram and power spectral density of surface of thin films calculated from AFM images.

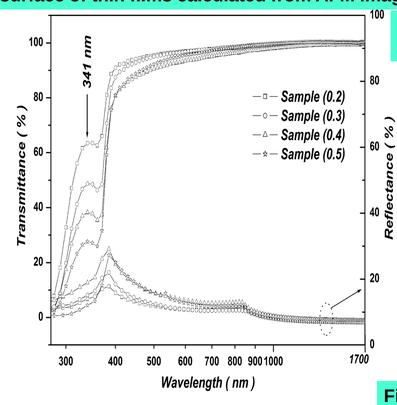


Fig. 9 Optical transmittance and reflectance spectra for different sol concentration

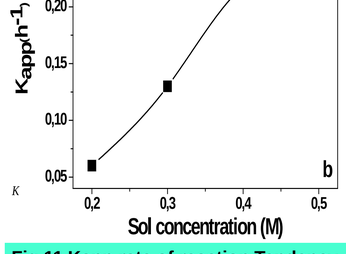


Fig.11 Kapp rate of reaction Tendency given by ZnO films with sol concentration.

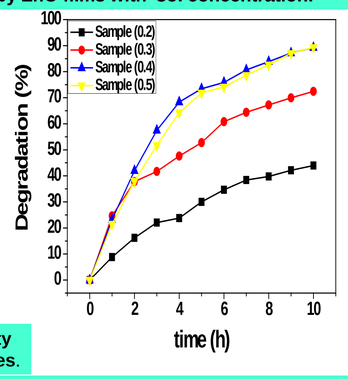


Fig.12 MB percentage degradation after 10h of irradiation with various sol concentration.

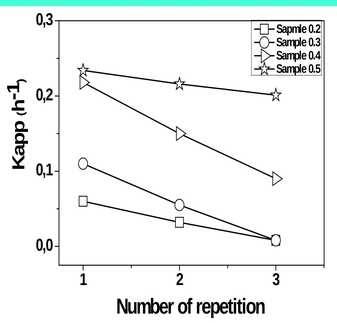


Fig.13 Kapp rate of reaction tendency along 3 degradation cycles given by ZnO films

Table 2.Roughness parameters

	Sample 0.2	Sample 0.3	Sample 0.4	Sample 0.5
R_a(nm)	7.9	7.8	6.7	5.5
R_q(nm)	6.4	5.8	5.2	4.3
λ (nm)	450	830	470	550
β	4.3	3.6	4.5	4.2

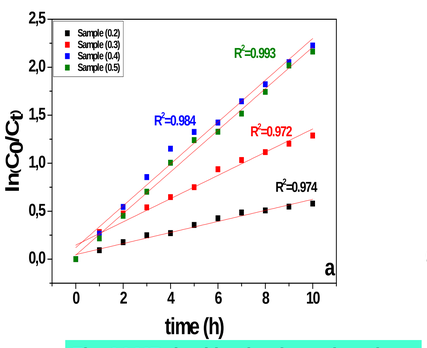


Fig. 14 MB dye kinetic of reaction given by ZnO films with sol concentration.

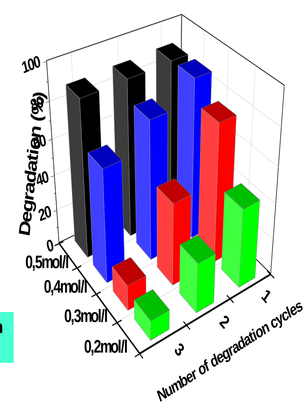


Fig. 16 ZnO thin films photocatalytic activity stability with sol concentrations along 3 degradation cycles

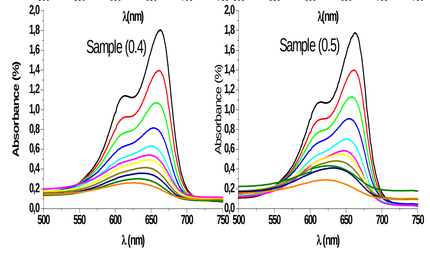


Fig. 15 MB absorption spectra evolution by ZnO thin films with various sol concentration.

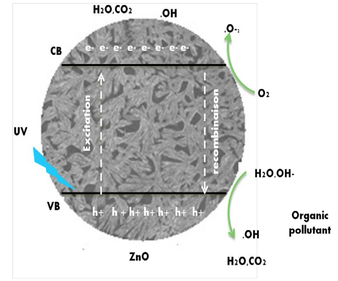


Fig. 17 : MB degradation mechanism In contact with ZnO

Table 3. Optical band gaps energy and stress of ZnO thin films.

	Sample 0.2	Sample 0.3	Sample 0.4	Sample 0.5
E_g (eV)	3.296	3.287	3.290	3.289
• (%)	0.560	0.464	0.556	0.484
• (GPa)	-1.30	-1.08	-1.29	-1.13

Conclusions

- ZnO Nanofibers successfully elaborated by sol-gel method for photocatalysis.
- ZnO films growth starts with nanoparticles that agglomerates into sword-like nanofibers
- Sol concentration and stability of the films effects were investigated
- The random orientation of ZnO nanofibers improve the photocatlytic performance
- Photocatalytic efficiency is greater than 92 % for 0.5M
- ZnO nanofibers density improve the photocatlytic performance

Acknowlegments

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