THIRD GENERATION PHOTOACTIVE MATERIALS

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INTRODUCTION

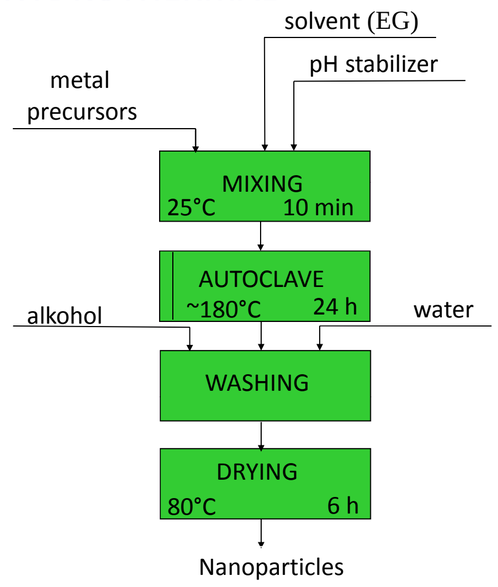
In order to find more efficient photocatalysts under visible light, semicoductor nanomaterials were synthesized. The new nanocomposites can be activated by low powered and low cost irradiation sources (such as LEDs or blacklight fluorescent UV lamps) [1].

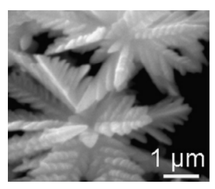
The aim of the research is to prepare third generation nanostructures *via* sol-gel and hydrothermal method. Previously synthesized nanocomponents (as shown in Table 1.) will be combined to one products. The procedure based on Serpone's theory (see details in Fig. 3.).

The received nanostructures will be characterized by BET measurement, UV-Vis spectra, X-ray diffraction and scanning electron microscope. The photoactivitie of the materials will be investigated under UV and visible light by photodegradation of phenol (in a aqueous phase) and toluene (in a gaseous phase).

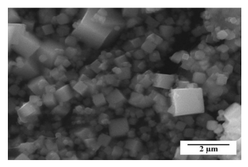
PREPARATION ROUTE

HYDROTHERMAL





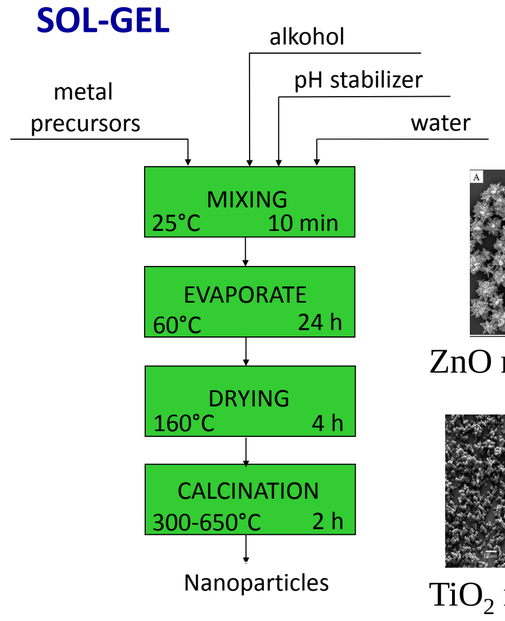
CdS nanoleaves [3]

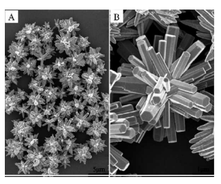


$SrTiO_3$ nanocubes [4]

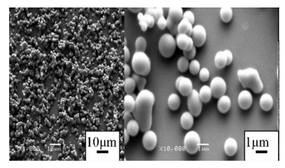
Fig. 1. Block diagrams of semiconductor nanoparticles preparation by a hydrothermal methods and the SEM image of a products

SOL-GEL





ZnO nanoflowers [5]



TiO_2 nanospheres [6]

Fig. 2. Block diagrams of semiconductor nanoparticles preparation by a sol-gel methods and the SEM image of a products

HYDROTHERMAL METHOD SET- UP

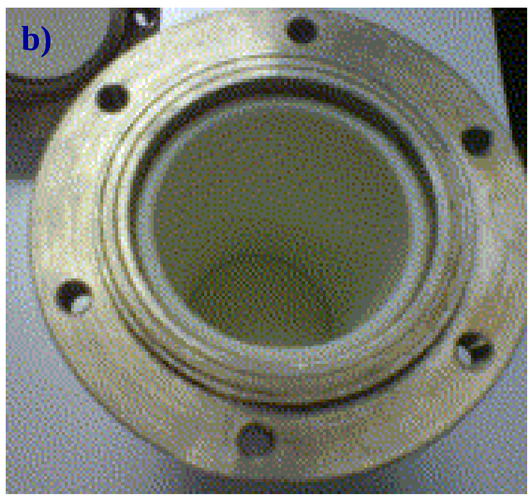


Fig. 3. Set-up for hydrothermal synthesis: (a) hydrothermal reactor, (b) teflon inset

CONCEPT OF THIRD GENERATION PHOTOCATALYSTS

1) **VB to CB electronic transition in solid A**
2) **Generation of free electrons and holes**
3) **Hole transfer occurs from A to C (VB position of solid A lower than the VB band of solid C)**
4) **Generation of electrons and holes in photoexcited solid B (CB position of solid C higher in energy than the CB of solid C)**
5) **Electron transfer from B to C**
6) **Transfer of electrons from A to B and recombination of electrons in A with holes generated in B**

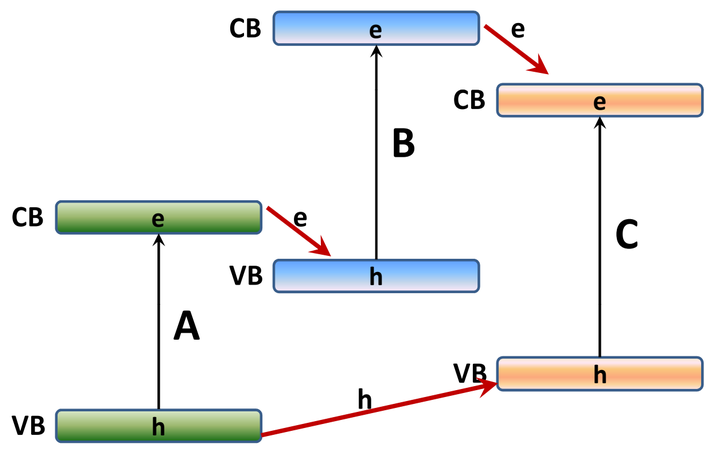


Fig.4. Schematic diagram of electrons and holes pathway in photoexcited third generation materials [1]

Combinations of semiconductors and their electronic properties according to Serpone's theory

Nano-composite No.	Semiconductor A			Semiconductor B			Semiconductor C			Preparation method
I	Nb_2O_5			TiO_2			ZnO			sol-gel
	Band gap (eV)	VB position (V)	CB position (V)	Band gap (eV)	VB position (V)	CB position, (V)	Band gap (eV)	VB position (V)	CB position (V)	
	3.4	3.4	0	3-3.2	2.9	-0.1	3.2	3.2	0	
II	$KTaO_3$			CdS			WO_3			hydro-thermal
	Band gap (eV)	VB position (V)	CB position (V)	Band gap (eV)	VB position (V)	CB position, (V)	Band gap (eV)	VB position (V)	CB position (V)	
	3.4	3.1	-0.3	2.4	1.8	- 0.6	2.8	3	0.2	
III	$KTaO_3$			GaP			$SrTiO_3$			hydro-thermal
	Band gap (eV)	VB position (V)	CB position (V)	Band gap (eV)	VB position (V)	CB position, (V)	Band gap (eV)	VB position (V)	CB position (V)	
	3.4	3.1	-0.3	2.25	1.3	-0.95	3.2	3	-0.2	

SUMMARY

Following Serpone's theory might lead to develop next generation of photocatalysts. The mechanism is based on multi (two)- photon excitation of nanomaterials with lower energy photons. Therefore it is possible to achive the same excited state as with higher energy photons. The utilization of heterojunctions allows to drive the electronic processes in the desired direction. This theory assures better selectivity of semicoductor nanomaterials becouse of the selective photoexcitation of localized electronic states.

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