NANOCOMPOSITIES FOR PHOTOCATALYTIC AIR TREATMENT

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INTRODUCTION

One of the challenges in the field of photocatalytic air treatment systems is the development of third generation of photoactive materials activated by low powered and low cost irradiation sources (such as LEDs). In this work we prepared semiconductor and their combination using a hydrothermal methods. Photocatalytic activity of prepared nanocomposites was estimated by photocatalytic degradation of toluene in the gas phase using a source of irradiation: LED 375nm (Fig. 1B).

PHOTOCATALYTIC SET-UP

Photocatalysts was applied on substrate support using painting techniques (semiconductors suspended in solvent was paint at the surface of glass piece and dried, placed in the reaction chamber (see Fig. 1A), purged with gas containing toluene, closed and irradiated using light emitting diodes (LED). The model compound formed during irradiation concentration in the gas phase will be estimated by GC with FID detector.

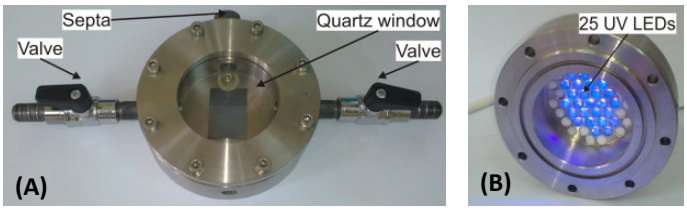

Fig. 1. Pictures of (A) photoreactor and (B) light sources LEDs 375 nm used for degradation of toluene in gas phase

PREPARATION PROCEDURE

Table 1. Preparation method of semiconductors $KTaO_3$, CdS and MoS_2 and theirs combination

Semiconductor A	Semiconductor B	Semiconductor C
$KTaO_3$	**CdS**	**MoS_2**
The mixture of KOH and Ta_2O_5 solution with PEG was heated in an autoclave at 200°C for 24h. The powder product was filtered off, washed and dried [2].	Aqueous solution $CdCl_2$, ethylene glycol and thiourea was heated in an autoclave at 190°C for 24 h. The products were washed and dried [3].	$Na_2MoO_4 \cdot 2H_2O$, thiourea and PEG were dissolved in H_2O, transferred into autoclave and heated at 200 °C for 24 h. The precipitate was washed and dried [4].
Molar ratio of semiconductors		
0	1	1
0	4	1
0	5	1
0	1	5
10	5	1

RESULTS

Table 2. The efficiency of toluene photodegradation over semiconductors (four cycles of irradiation; irradiation source: LEDs 375 nm)

The efficiency of toluene photodegradation [%]				
Sample	Number of cycles			
	I	II	III	IV
CdS	57	57	57	52
MoS_2	46	23	22	22
$KTaO_3$	64	63	42	37
CdS 1: 1 MoS_2	61	53	62	52
CdS 4: 1 MoS_2	53	56	70	61
CdS 5: 1 MoS_2	69	60	49	48
CdS 1: 5 MoS_2	57	52	44	26
10 $KTaO_3$: 5 CdS: 1 MoS_2	59	56	56	55

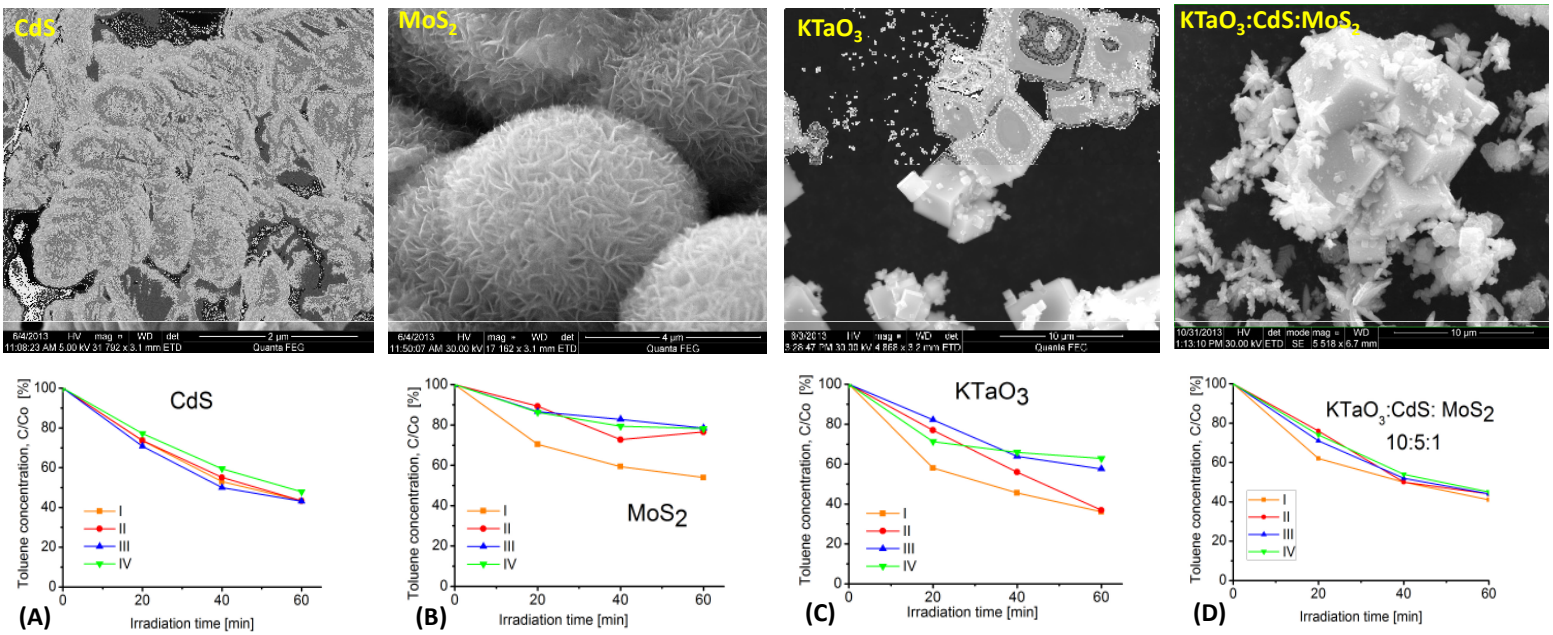

Fig.3. SEM images and efficiency of toluen photodegradation in the presence of: (A) CdS, (B) MoS_2, (C) $KTaO_3$, (D) $KTaO_3$:CdS :MoS_2 10:5:1

CONCLUSIONS

It was observed that semiconductors CdS, $KTaO_3$ and MoS_2 and theirs combinations caused an increase of the photocatalytic activity. After 1 hour degradation of toluene in the presence of CdS was 57 percent and activity doesn't change after four cycles of irradiation. While the photoactivity MoS_2 and $KTaO_3$ decreased after subsequent irradiation. We have prepared a series combination of two semiconductors CdS and MoS_2. We have observed that adding a small amount of MoS_2 to the CdS nanoparticles causes an increase of the photoactivity and stability of semiconductors with subsequent irradiation. With the increase ratio of MoS_2 to the CdS we showed that the photactivity of nanocomposities decreased after four cycles of irradiation. The photoactivity of combination three semiconductors (10 $KTaO_3$: 5 CdS: 1MoS_2) after 1 hour was about 57 % and it doesn't change after after subsequent irradiation.

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