

Visible-light active TiO₂ for microwave assisted photocatalytic reactions using mercury electrodeless discharge lamps



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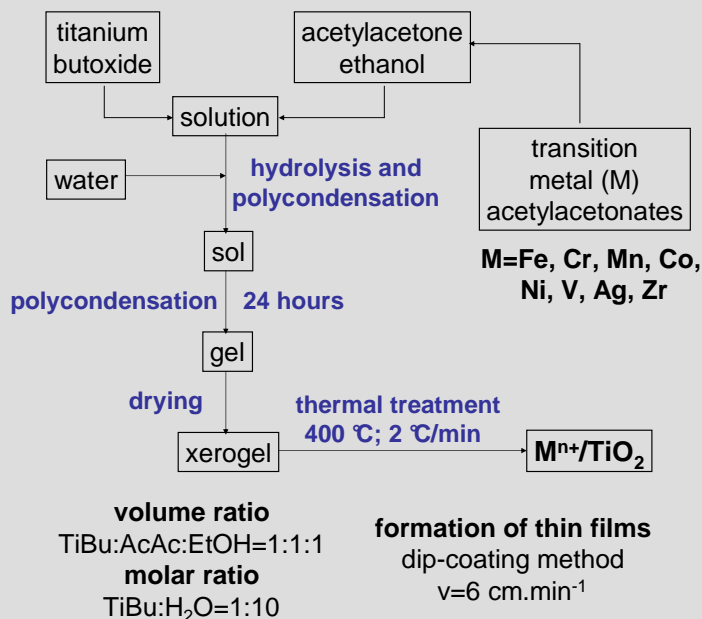
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Introduction

The photocatalytic reactions using active titanium dioxide have been successfully developed as a method for remediation of contaminated water and purification of polluted air. The research is aimed to prepare a visible-light response photocatalyst via transition metal ions doping. Titanium dioxide nanoparticles doped with various ions of transition metals Mⁿ⁺ (M=Fe, Cr, Mn, Co, V, Ni, Ag, Zr) were prepared by using the sol-gel method based on hydrolysis of titanium butoxide. The photocatalytic activity was evaluated by the degradation of mono-chloroacetic acid in a microwave field using mercury electrodeless discharge lamps [1].

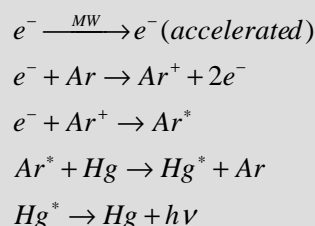
Experimental

Preparation of doped titanium dioxide



Electrodeless discharge lamp and experimental set-up

Principle of operation



Preparation

glass envelope-Pyrex
20x40 mm
filling material
2.5 μl Hg
inert gas
argon, 20 Torr



coated EDL

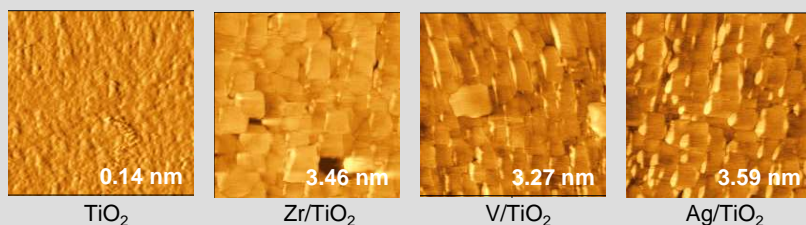
150 ml mono-chloroacetic acid
c₀=0.1 mol/l; 900 W; 5.5 μW·cm⁻²



experimental set-up

Results

Atomic Force Microscopy (AFM)



significant absorption in visible region shows these three samples

raman spectroscopy revealed anatase as a predominant crystalline phase for pure/doped TiO₂

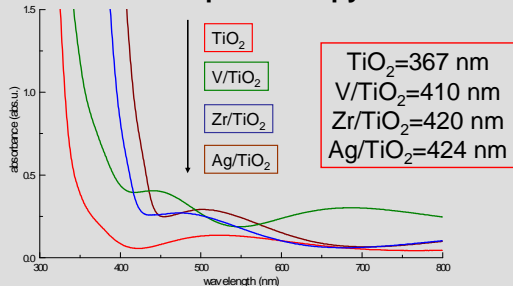
addition of transition metals changes the morphology of prepared layers
amount of transition metal ions in wt.% was determined by electron microprobe

Electron microprobe (EMP)

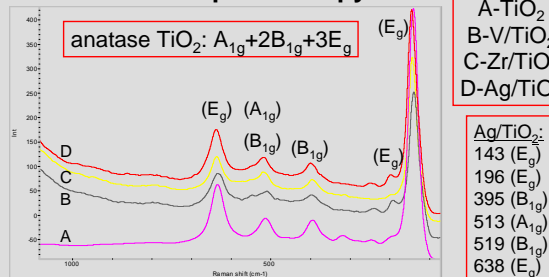
	x(wt.%)	thickness (nm)
Zr/TiO ₂	2.13	149
V/TiO ₂	2.24	143
Ag/TiO ₂	0.095	115

no effect - Fe, Co, Ni, Mn, Cr
silver doped titania layers show the highest activity in a microwave assisted photocatalysis of MCAA

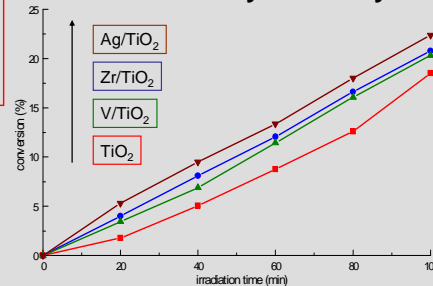
UV-Vis spectroscopy



Raman spectroscopy



Photocatalytic activity



Conclusion

Compared with pure titania, the UV-Vis spectra of Ag⁺, Zr⁴⁺ and VO²⁺ doped titanium dioxide show significant absorption in visible region. The degradation efficiency of MCAA in a microwave field on these TiO₂ layers was higher than those of pure TiO₂.

Acknowledgements

The authors thank the Grant Agency of the Czech Republic for funding this research (Grant No. 104/06/0992). In addition, Hana Žabová thanks the Grant Agency of the Czech Republic for part funding her PhD studentship (Doctoral Grant No. 203/08/H032).

References

[1] V. Církva, H. Žabová, M. Hájek, J. Photochem. Photobiol. A: Chem. 198 (2008) 13-17.