The Electrodeless Discharge Lamps Coated with the Titania Thin Film for Photocatalysis in a Microwave Field

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Introduction

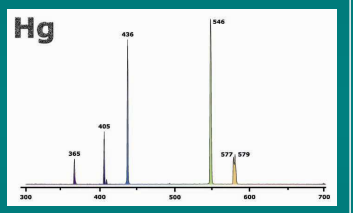
Microwave irradiation has been used to assist photochemical and photocatalytic reactions for degradation of organic pollutants. The electrodeless discharge lamp (EDL) generates UV/VIS radiation when placed into the microwave field and is connected to the objective of microwave photochemistry [1]. The degradation of mono-chloroacetic acid (MCAA) by microwave assisted photocatalysis using TiO_2 thin films has been examined. Several factors influencing the degradation of MCAA have been studied in detail [2].

Experimental

PREPARATION of EDL

The EDL blank was thoroughly cleaned in water-soap mixture, distilled water, aqueous hydrofluoric acid and ethanol. 2.5 µl Hg and stainless steel thin wire were placed to the EDL blank. The system was flushed with argon and sealed under 20 Torr vacuum.

coated EDL



emission spectrum of EDL

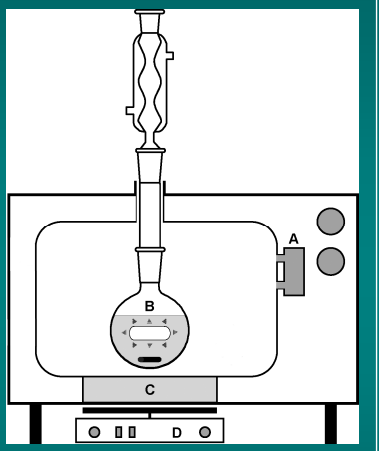
Principle of operation

$$e^- \xrightarrow{MW} e^-(accelerated)$$

$$e^- + Ar \rightarrow Ar^+ + 2e^-, e^- + Ar^+ \rightarrow Ar^*$$

$$Ar^* + Hg \rightarrow Hg^* + Ar, Hg^* \rightarrow Hg + h\nu$$

EXPERIMENTAL SET-UP



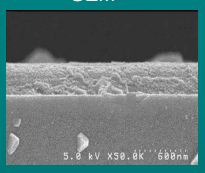
batch reactor

A-magnetron
B-reaction mixture, EDL
C-aluminium plate
D-magnetic stirrer

PREPARATION of TiO_2 thin film

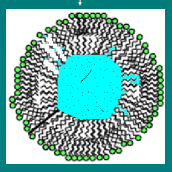
AFM

SEM



neinogenic surfactant Triton X-100

cyclohexane | water



reverse micelle

dropwise | titanium isopropoxide

raw gels, polymeric structure, -O-Ti-O- chains

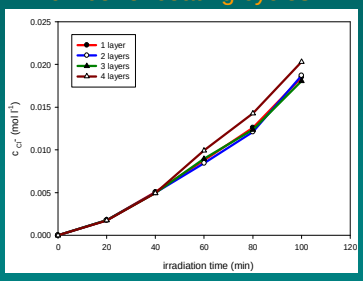
TiO_2 layer

dip-coating method

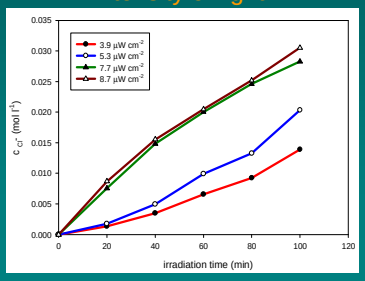
drying, calcination (400 ℃)

Results

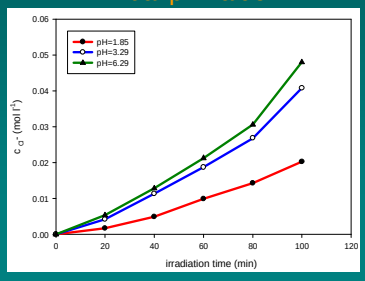
Number of coating cycles



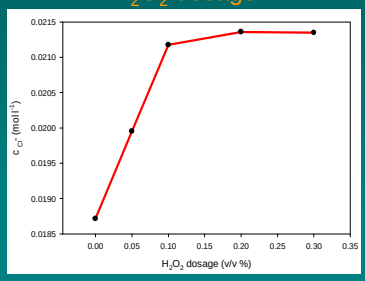
Intensity of light



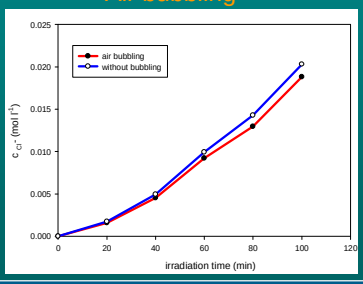
Initial pH value



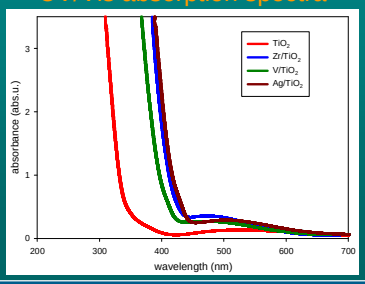
H_2O_2 dosage



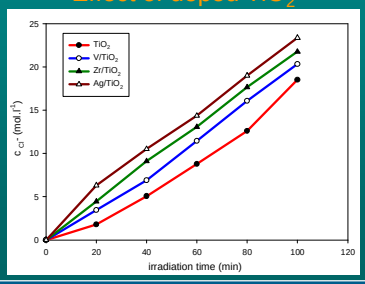
Air bubbling



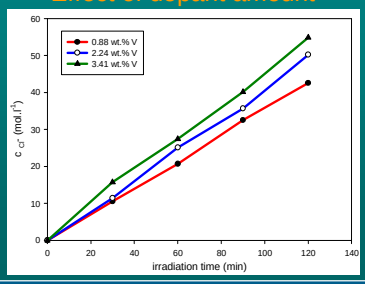
UV/Vis absorption spectra



Effect of doped TiO_2



Effect of dopant amount



Conclusion

The decomposition of MCAA in a MW field was enhanced in an alkaline solution and in the presence of H_2O_2. The UV/VIS spectra of V, Zr and Ag doped TiO_2 show significant absorption in VIS region and the degradation efficiency was higher than those of pure TiO_2.

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References

[1] P. Klán, V. Církva, Microwaves in Photochemistry, in:A.Loupy, Microwaves in Organic Synthesis, Wiley/VCH, Weinheim, 2006, pp. 860-897.
[2] V. Církva, H. Žabová, M. Hájek, J. Photochem. Photobiol. A: Chem. 198 (2008) 13-17.