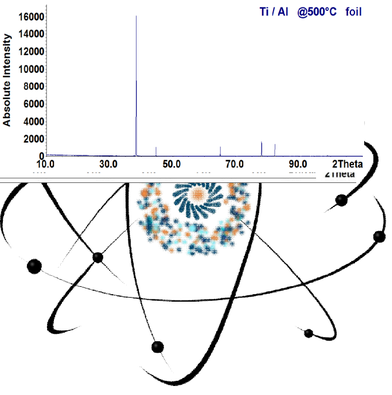

Photocatalytic destruction of prometryn on Ti-containing aluminum foil nanocomposites

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Introduction

The development of the agrochemical industry has dramatically increased in the last few decades due to widespread intensive agricultural activities. Increasing pesticides application and improper wastewater disposal methods are of particular concern for the freshwater (surface and groundwater), coastal and marine environments.

In this study, the heterogeneous photocatalytic degradation of a triazine herbicide prometryn using Ti-containing composites supported on aluminum foil as photocatalyst has been investigated. Prometryn, (2,4- bis(isopropylamino)-6-methylthio-1,3,5-triazine) is a leafand root-herbicide for general and selective use. Its chemical stability enables it to penetrate slowly through the soil causing a long-term contamination of underground resources of water.

Methods

The nanoscale photocatalytic layers with titania on aluminum foil were prepared by low temperature ionic implantation method. Metallic Ti was used as an implant. The cathode sputtering of the target (Ti) was carried out by N_2 ions. The energy of implantation was 20 keV at a fluence of 5×1017 ions/cm^2. The camera for implantation allows one receiving samples with the maximum linear sizes 30×30 cm.

The samples were studied by XRD, AFM and SEM-EDX methods. The prepared Ti-containing aluminum foils (Ti/Al foil) were calcinated in air at the temperature range of 200–600 °C and determined as Ti/Al/T °C.

The photocatalytic properties of the samples in degradation of prometryn in aqueous solutions (1.5×10^{-6} mol/l) was determined under visible and UV irradiation.

The study was carried out in a cylindrical reactor (9 cm diameter) with a wall-placed 10 cm height sample (implantation on both sides of the foil) and immersed thermostatically controlled radiation source. The source of radiation (high pressure mercury or sodium lamps were used) was placed in reactor center, which permits to implement the investigation in both UV and visible range. The reaction products were analyzed on a SelmiChrom-2 gas chromatograph equipped with an FID on a stainless-steel column (length 3 m, diameter 3 mm) filled with quartz sand.

Results

The XRD data shown that all reflexes of our samples correspond to metal aluminum

The absence of the reflexes of implanted titanium or its compounds may indicate their amorphous state or a low concentration in the surface layer of the composite. (fig. 1).

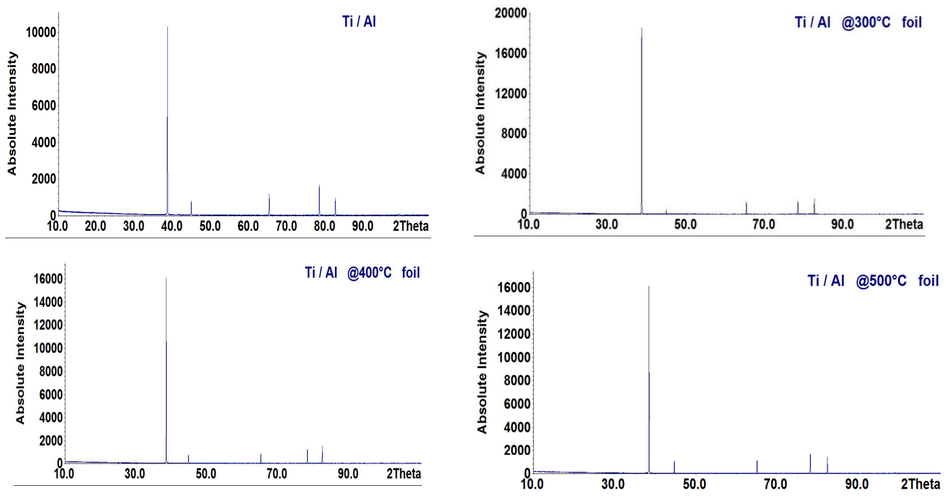
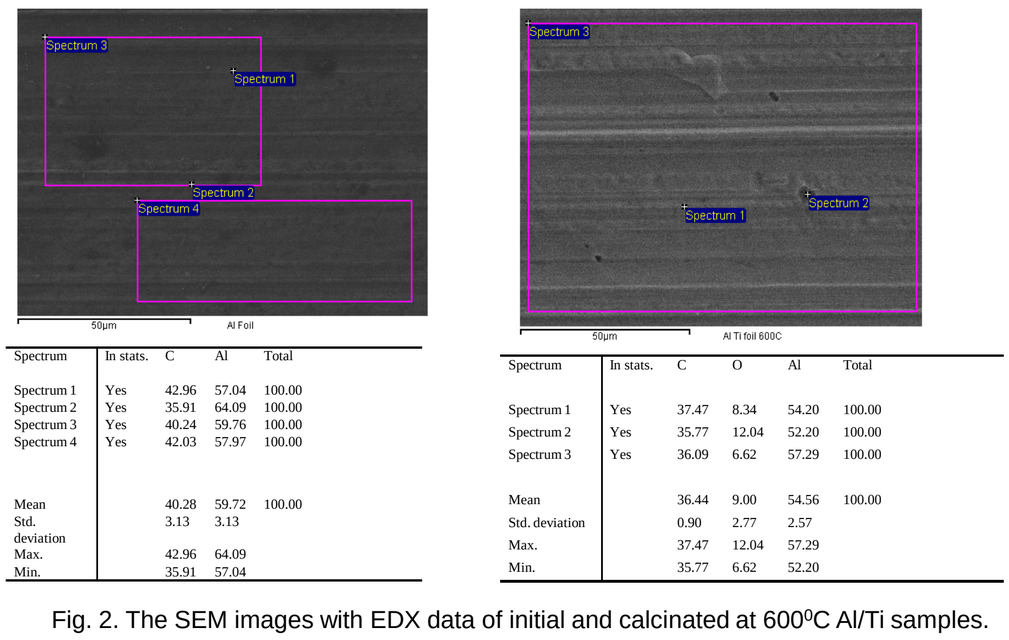


Fig. 1. XRD patterns of the catalyst supported on aluminum foil



Spectrum	In stats.	C	Al	Total
Spectrum 1	Yes	42.96	57.04	100.00
Spectrum 2	Yes	35.91	64.09	100.00
Spectrum 3	Yes	40.24	59.76	100.00
Spectrum 4	Yes	42.03	57.97	100.00
Mean		40.28	59.72	100.00
Std. deviation		3.13	3.13	
Max.		42.96	64.09	
Min.		35.91	57.04	

Spectrum	In stats.	C	O	Al	Total
Spectrum 1	Yes	37.47	8.34	54.20	100.00
Spectrum 2	Yes	35.77	12.04	52.20	100.00
Spectrum 3	Yes	36.09	6.62	57.29	100.00
Mean		36.44	9.00	54.56	100.00
Std. deviation		0.90	2.77	2.57	
Max.		37.47	12.04	57.29	
Min.		35.77	6.62	52.20	

Fig. 2. The SEM images with EDX data of initial and calcinated at 600^{0}C Al/Ti samples.

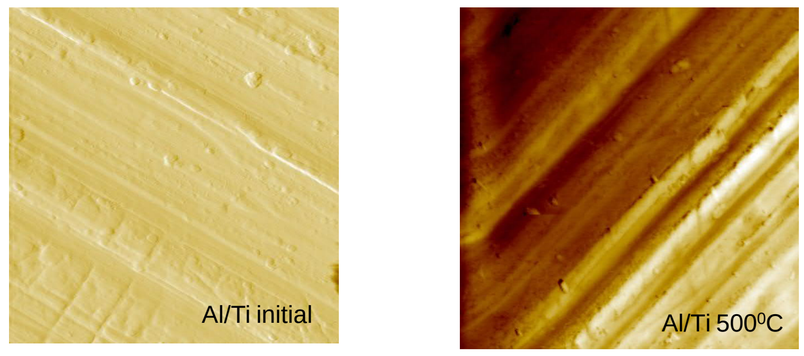


Fig. 3. AFM data of initial and calcinated samples.

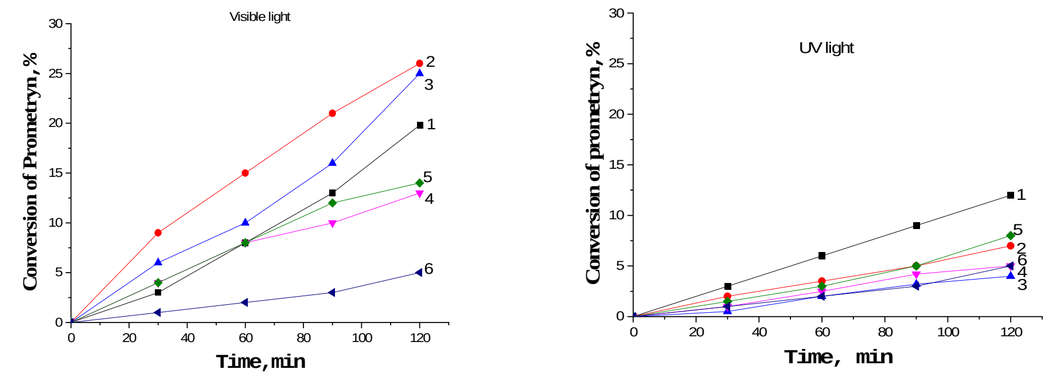


Fig.4. Photocatalytic activity of Ti/Al samples in prometryn degradation reaction. 1- Ti/Al; 2- Ti/Al/200°; 3- Ti/Al/300°; 4- Ti/Al/400°; 5- Ti/Al/500°; 6 – Ti/Al/600°

Conclusion

It is shown that as a result of ionic implantation of Ti on the surface of a aluminum foil successfully obtained a nanocomposite active in the photodestruction of prometryn. The most active samples under visible irradiation were pre-calcinated at 200 and 300 ^{0}C. Increasing of the temperature heat treatment has a negative effect on the samples activity both with visible and UV-irradiation.

Thus, the availability and practicality of using the obtained samples in the process of prometryn removing from its aqueous solutions in the visible radiation has been shown, which is extremely important from an environmental point of view

Acknowledgements

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