Photocatalytic activity of nanosized TiO_2/Al_2O_3 and TiO_2/MgO composites synthesized by ultrasonic method in the decomposition of metronidazole

Zabolotnii Ye.V.[1], Zazhigalov V.O.[1], Kotynska L.Y.[1], Tsyba M.M.[1], Kordan V.M.[2], Kurmach M.M.[3]

[1]*Institute for Sorption and Problems of Endoecology, National Academy of Sciences of Ukraine.03164, Kyiv, General Naumov st., 13. E-mail: evgeniy2019q@ukr.net*

[2]*Ivan Franko National University of Lviv, 1 Universytetska Street, Lviv 79000, Ukraine*

[3]*L.V. Pisarzhevsky Institute of Physical Chemistry, National Academy of Sciences of Ukraine, 31 pr. Nauky, Kyiv 03028, Ukraine*

Introduction. One of the promising methods of decomposition of the drugs, especially antibiotics, such as metronidazole, which contaminate water sources, is the photocatalytic destruction of these substances on heterogeneous catalysts, among which TiO_2 is one of the most popular. However, this catalyst has a number of disadvantages, so the intensive search of the systems with improved characteristics on the base of complex oxides composition (including TiO_2) and the methods of their synthesis attracts the attention of the most scientific lab.

The physico-chemical parameters samples **Tab.1.**

Parameter	TiO_2 initial	TiO_2 UST, 30 min	TiO_2/Al_2O_3 1:1		TiO_2/MgO 1:1	
			initial	UST, 30 min	initial	UST, 30 min
S_{BET}, $м^2/g$	10,2	9,0	30,2	34,0	10,0	95,2
V_S, $см^3/g$	0,41	0,11	0,17	0,24	0,14	0,37
R_a, nm	804	253	111	142	275	78
L_{max}, nm	38,2	45,3	46,6	50,3	48,5	50,9
K_d, s^{-1}	0,77	0,92	0,79	0,12	0,58	0,33
G, %	100	99	98	48	96	82

Methods. The ultrasonic treatment (UST) of the samples TiO_2, and TiO_2/Al_2O_3, TiO_2/MgO oxides mixtures with a molar ratio of 1:1 in aqueous medium was realized in this study. Photocatalytic destruction of metronidazole (MNZ, C = 0.015 g/l) in aqueous solution was investigated under UV irradiation. The concentration of MNZ was determined after each hour of the reaction at adsorption band with maximum at 320 nm. The maximum time of the reaction was equal to 5 hours.

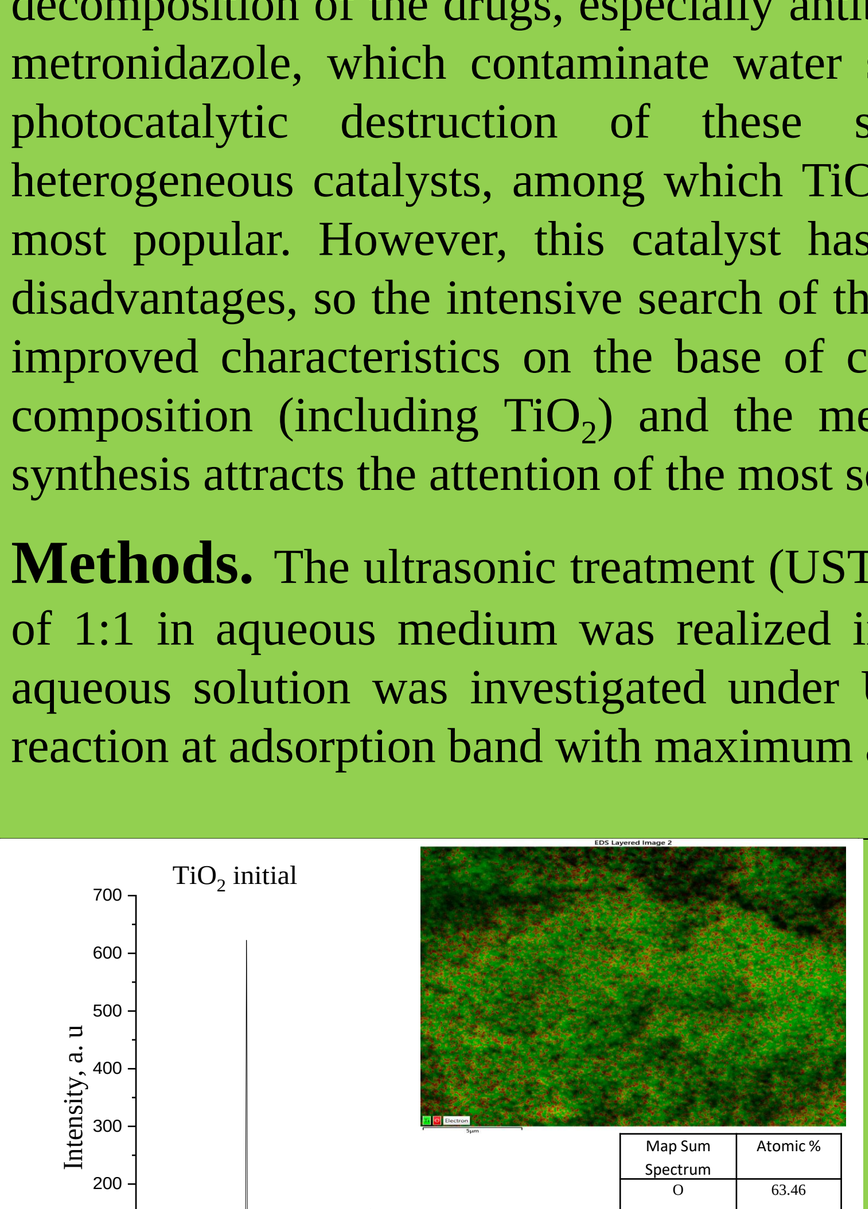

Fig.1. XRD and SEM data of TiO_2 initial

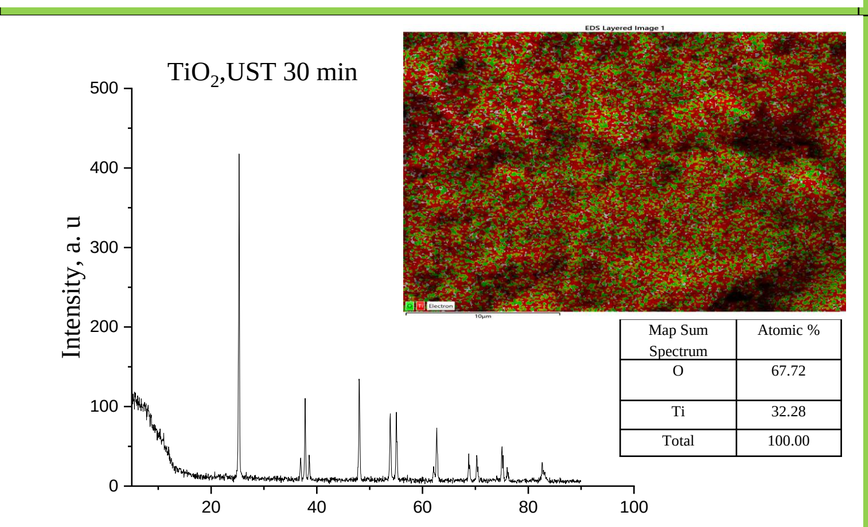

Fig.2. XRD and SEM data of TiO_2,UST 30 min

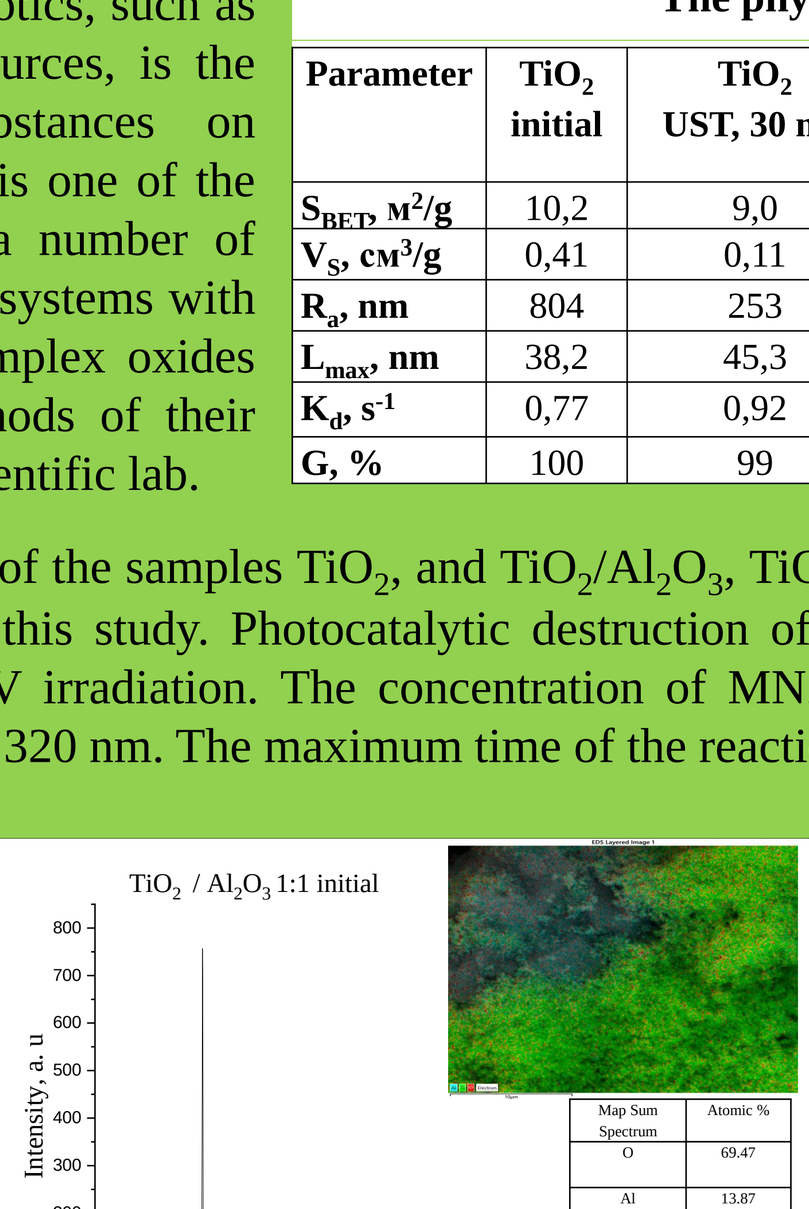

Fig.3. XRD and SEM data of TiO_2/Al_2O_3 1:1 initial

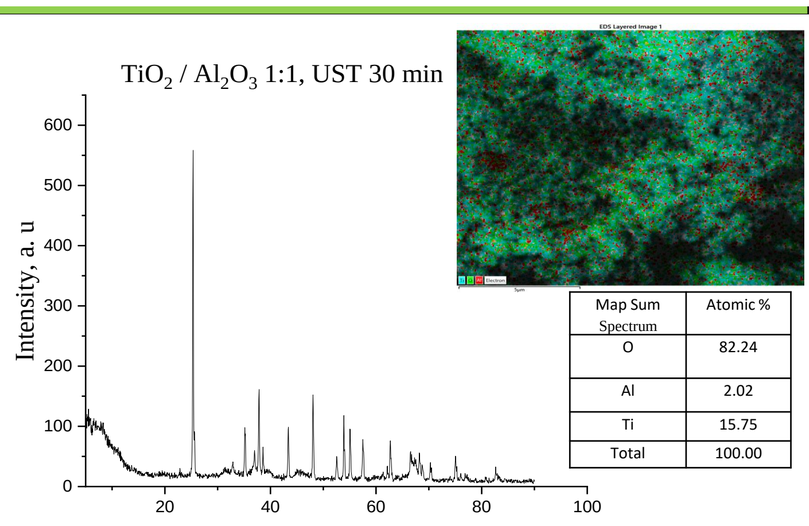

Fig.4. XRD and SEM data of TiO_2/Al_2O_3 1:1,UST 30 min

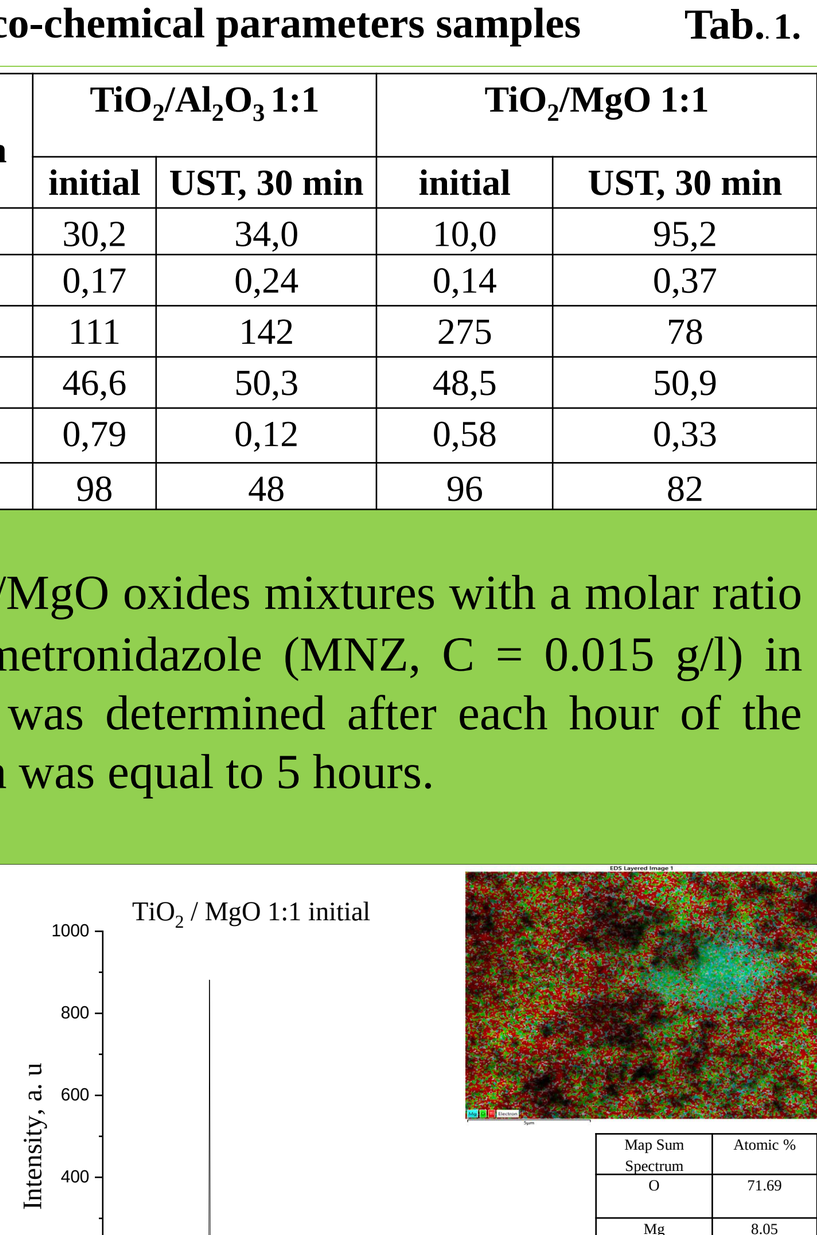

Fig.5. XRD and SEM data of TiO_2/MgO 1:1 initial

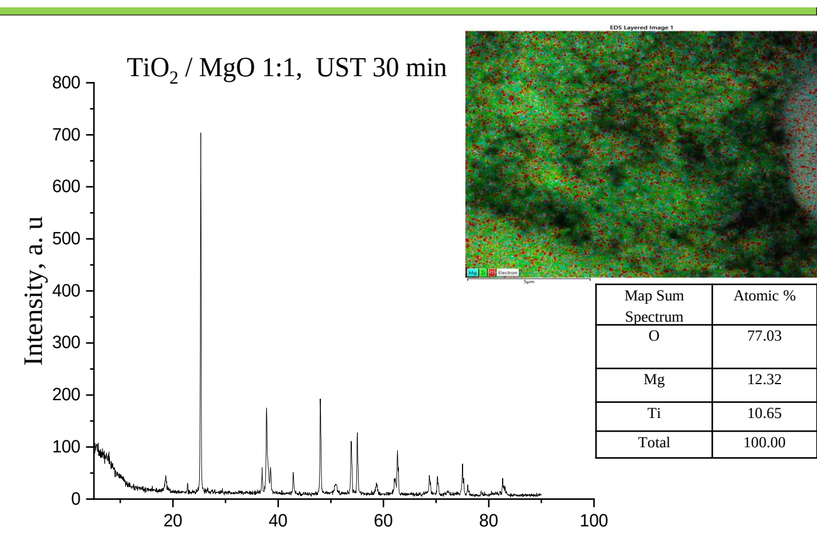

Fig.6. XRD and SEM data of TiO_2/MgO 1:1,UST 30 min

Results. It was shown that UST permits to obtain the homogeneous and dispersed samples with lower peak intensity than the initial oxides mixtures (**Fig.1 – 6**). It was established that the treated TiO_2 demonstrates the maximal activity in MNZ decomposition but initial oxides mixtures have the significantly higher photocatalytic activity (K_d) and the degree of metronidazole photodegradation (G) than the modified system under the action of UV light (**Tab.1.**).

Conclusion. Photocatalytic activity of nanosized TiO_2/Al_2O_3 and TiO_2/MgO composites synthesized by ultrasonic method in the decomposition of metronidazole is lower than in the initial samples because possible the formation of new phases or solution of active component – TiO_2 by introduction of alumina or magnum oxide.