SYNTHESIS OF METAL-CERAMIC COMPOSITES BASED ON SILICON NITRIDE IN THE COMBUSTION MODE AND CATALYTIC ACTIVITY[1]

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At present, heterogeneous photocatalysis and the high oxidizing capability of hydroxyl radicals are successfully used to remove soluble organic substances [1]. Ozonizing and UV radiation in the presence of oxygen-containing catalysts and reagents contribute to the formation of OH radicals. The ferrioxalate system and photo-Fenton are photoactive in homogeneous catalysis.

The results showed that iron-containing composites based on boron, silicon and sialon nitrides exhibited high catalytic activity under UV radiation during the degradation of oxalic acid, phenols, formaldehyde, and colouring agents [2].

The catalytic activity of materials was found to be caused by the presence of iron in the composition of matrix and the formation of photoactive systems such as the photo-Fenton (Fe^{2+}/H_2O_2/UV), ferrioxalate ($Fe(C_2O_4)_3^{3-}$/UV) and ferricomplexonate (FeEDTA/UV) systems in the solution by adding reagents (activators, H_2O_2, $H_2C_2O_4$, EDTA). The results also showed that the photoactivity of metal-ceramic composites during the degradation of soluble organic substances depends on the optical properties of matrix that contains semiconductor compounds.

To obtain a material based on silicon nitride, titanium and sialon, metallic titanium was added to the green mixture (aluminum ferrosilicon) in the amount of 5-40 wt.%.

The phase composition of combustion products depends essentially on the amount of titanium. Figure 1 shows the X-ray diffraction patterns of the synthesized samples.

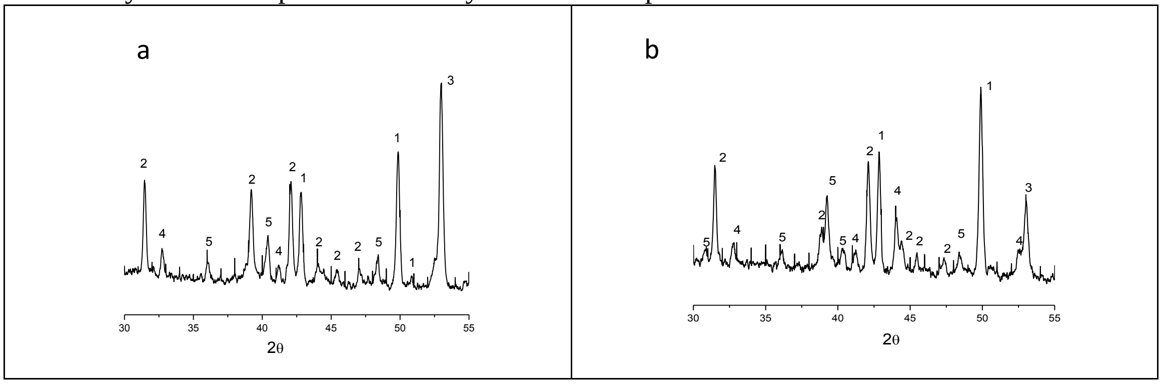

Fig.1. X-ray diffraction patterns of aluminum ferrosilicon+15%Ti(a) and aluminum ferrosilicon+20%Ti(b) (1-TiN, 2 -β- Si_3N_4, 3-Fe, 4 – FeSi, 5 - α- Si_3N_4)

The catalytic activity of synthesized composites (samples (a) and (b)) was evaluated during the degradation of colouring agents (methylene blue, eosin). The results have shown that the greatest degradation of methylene blue is observed in the presence of $H_2C_2O_4$ (ferrioxalate system) and reaches 67-73 wt.%. When eosin is disintegrated, a high activity is exhibited by the composite *a* with an additive of EDTA (ferricomplexonate system). In addition, an increase in the concentration of EDTA by an order of magnitude ($2 \cdot 10^{-4}$–$2 \cdot 10^{-3}$ M) leads to the increase in the oxidation degree of eosin by more than 2 times (from 35 to 85wt.%).

Thus, iron-containing metal-ceramic composites based on silicon and titanium nitrides are promising for purification of waste water from colouring agents, using UV radiation.

REFERENCES

1. *Oppenlander T.* // WILEY– VCH Verlag, 2003. 368 p.
2. *Skvortsova L.N., Chuklomina L.N., Mokrousov G.M., Batalova V.N., Wu J.J.* // Russian J. Appl. Chemistry. 2012. V. 85. No. 1. P. 2021-2025.

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