Photo- and X-ray sorption properties of magnesium fluoride

T.S. Minakova[1], E.P. Meshcheryakov[1], *I.A. Ekimova[1], A.V. Rudakova[2], V.K. Ryabchuk[2]*

[1]National Research Tomsk State University, [2]Saint Petersburg State University

E-mail: tminakova@mail.tomsknet.ru

Photo- and X-ray sorption properties of magnesium fluoride

- Magnesium fluoride is widely used in the optical and catalytic industries. In this regard, it is important to study the surface properties of MgF_2 and to search new effective photosorbents and photocatalysts.
- The purpose of this work is to study the photo- and X-ray sorption, photocatalytic properties of magnesium fluoride [1].
- In this paper finely-divided samples of magnesium fluoride type of “pure for optical ceramics” obtained from $MgCl_2$ - (MgF_2-1), (MgF_2-1a), and samples type of “pure for thermal pressuring” formed from basic magnesium carbonate – (MgF_2-2), (MgF_2-2a) have been studied.
- The acid surface along with acid-basic properties is typical for the samples of (MgF_2-1), (MgF_2-1a), while that for (MgF_2-2), (MgF_2-2a) is the neutral one [1, 2].

Photo- and X-ray sorption properties of magnesium fluoride

- Photo- and X-ray sorption of oxygen were examined on the samples mentioned above. Illumination of the samples was carried out with the help of full light of PRK-lamp. The portative apparatus REIS-I (a tube with copper anode) was used as a source of X-ray radiation (Fig.1). The ions of contaminated oxygen as well as F- and M- centers were considered to be possible centers of photostimulated oxygen adsorption on the studied samples. It was suggested that high temperature forms of (530 – 650 K) can be a result of dissociative adsorption of oxygen while low temperature forms (430 – 440 K) can be referred to the molecular forms of O_2–t types [4]. Photosorption capacity of the samples obtained in different ways is similar.

Photo- and X-ray sorption properties of magnesium fluoride

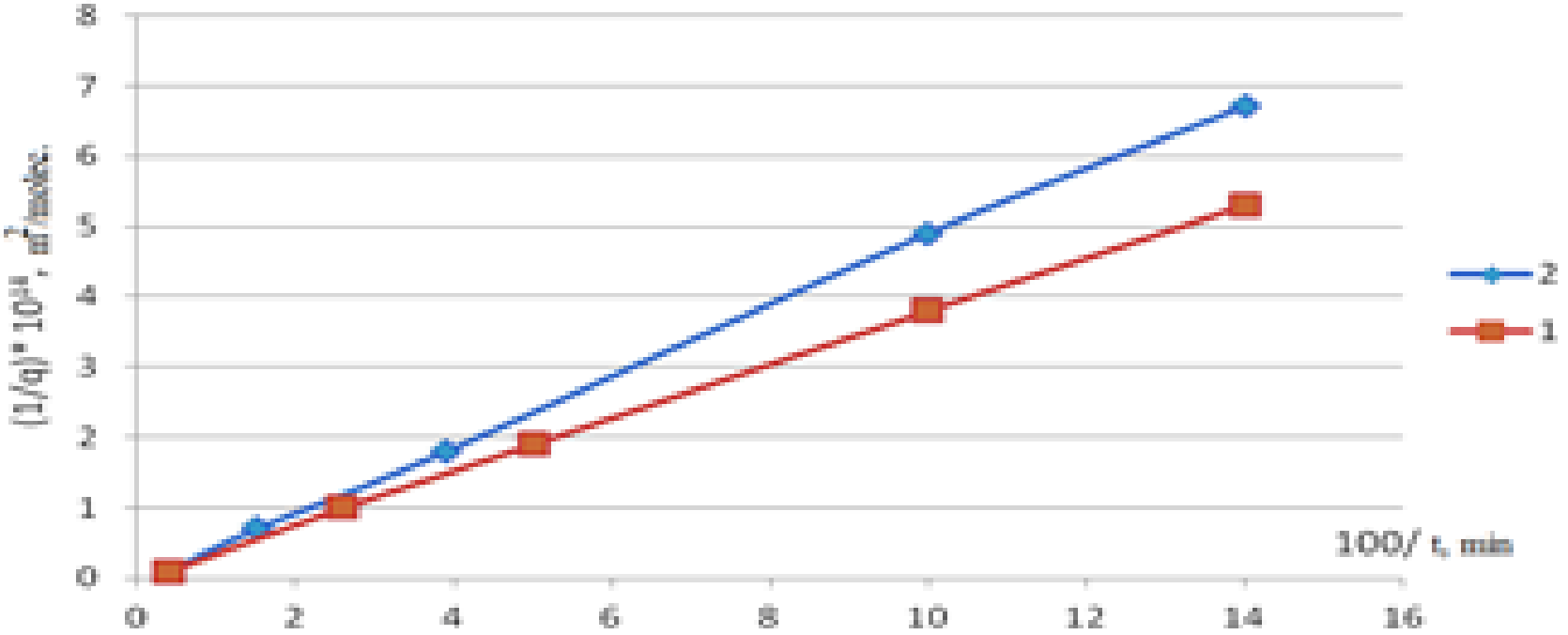

FIGURE 1. The kinetics for the oxygen X-ray sorption MgF_2 obtained from $MgCl_2$ (1) and a basic magnesium carbonate (2)

Kinetics of oxygen photosorption for all the samples has a power-law character. Kinetics of oxygen X-ray sorption on magnesium fluoride can be easily described with an equation of “local” kinetics.

Photo- and X-ray sorption properties of magnesium fluoride

- Spectra of X-ray-sorbed oxygen thermodesorption sharply differ from TD-spectra of oxygen photosorbed on these samples. This fact also confirms the different mechanism of these processes development [1].
- Spectra of thermodesorption after photosorption for (MgF_2-1) and (MgF_2-2) were similar according to the position of peaks and their intensity. Meanwhile in the spectra of oxygen postsorbed from “chloride samples” the intensive low temperature maximums (420 K) was observed. For “carbonate samples” peaks of less intensity with more equal distribution of intensity up to 780 K were registered (Fig. 2, 3).

Photo- and X-ray sorption properties of magnesium fluoride

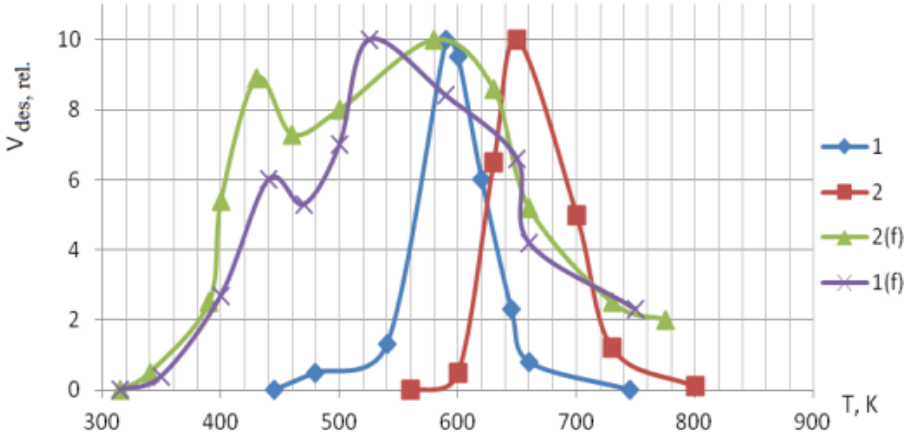

FIGURE 2. Thermal desorption spectra for oxygen MgF_2, prepared from magnesium chloride, (1, 1 (f)) and of basic magnesium carbonate (2, 2 (f)) : 1, 2 – after X-ray sorption; 1 (f) and 2 (f) after photosorption. The amount of adsorbed oxygen – 6.04* 10^{13} molecules / m^2, v – desorption rate.

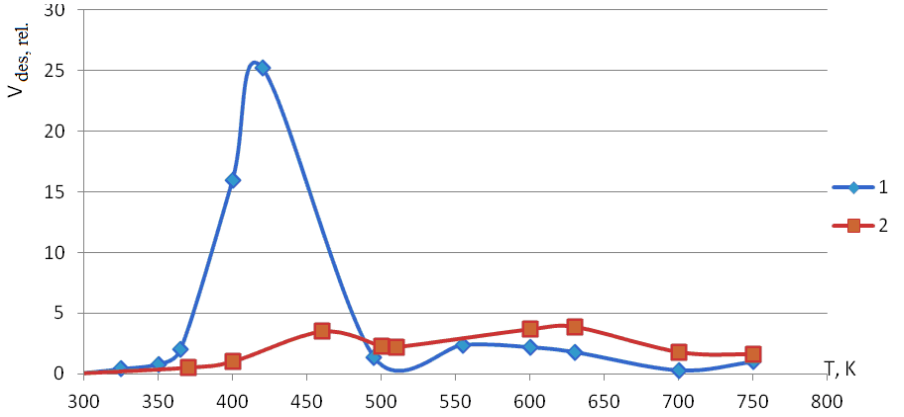

FIGURE 3: Thermal desorption spectra of oxygen sorber after UV irradiation of MgF_2 obtained from magnesium chloride (1), from basic magnesium carbonate (2).

Photo- and X-ray sorption properties of magnesium fluoride

As a result of an experimental study of the photocatalytic properties on the surface of magnesium fluoride, the reactions of dark hydrogen oxidation, photooxidation of H_2, CO, and CO_2 photolysis have been found [2]. It is proposed a probable mechanism of the hydrogen photooxidation reaction on the basis of the performed kinetic studies. A required stage of the process is oxygen photosorption. In the limiting stage of the reaction, electronically excited states of photosorption oxygen interact with molecular hydrogen in the gas phase and are deactivated by oxygen in the gas phase.

REFERENCES

[1] E.P Meshcheryakov. Sorption and X-ray stimulated processes on alkaline earth metals and magnesium fluorides: dis…candidate of chemical science./ E.P.Meshcheryakov – Tomsk, 1995. 155 pp.

[2] T.S. Minakova and I.A. Ekimova, Alkaline-earth metals and magnesium oxides and fluorides. Surface properties / T. S. Minakova, I. A. Ekimova. – Tomsk: Publishing House of Tomsk State Univer., 2014. 148 pp.

[3] I.A. Ekimova, "Phisico-chemical properties of the surface of alkaline-earth metals oxides and fluorides and systems on their basis," Ph.D. thesis. Tomsk University, 2011. 169 pp.

[4] A.V. Rudakova Physico chemistry of alkaline earth and magnesium fluorides surfaces and photostimulated processes which occur on them: dis…candid. of chemical science /A.V. Rudakova – Tomsk, 1999. 142 pp.