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The results of theoretical and experimental studies in problems of optoelectronics, solar power and semiconductor material science for photoconductive materials are adduced in this collection. The prospective directions for photoelectronics are observed.
For lecturers, scientists, post-graduates and students.

У збірнику наведені результати теоретичних і експериментальних досліджень з питань оптоелектроніки, сонячної енергетики і напівпровідникового матеріалознавства фотопровідних матеріалів. Розглянуто перспективні напрямки розвитку фотоелектроніки.
Для викладачів, наукових працівників, аспірантів, студентів.

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PREPARATION OF THE $Li_xNi_{1-x}O$-SOLUTION FOR GAS SENSORS

The properties of metal-oxides, which are used as sensitive elements for gases are discussed. The systems of metals with variable valence have been got on the base of the given metals acetates and acetates of metal of 1A group are shown.

Now the complex materials of different metal-oxides are used as the primary sensitive elements to gases (CO, CH_4, C_2H_2, NO_x, NH_3). These materials used more often than pure ones because of their high sensitive qualities. The most effective materials are the solid solution of oxides of variable valence metals which have the general formula $Me^I_x Me^{II}_{1-x}O$, where Me^I_x — is the first group metal of the periodic system and the $Me^{II}_{1-x}O$ — is variable valence metal. These systems have stable electrophysical characteristics owing the oxygen balance establishment between volume, surface and gas phase at high temperatures. At the same time these systems are very sensitive to adsorption of small gas portions. This quality is their main trait.

We have got the systems on the base of metals with variable valence. The systems have been got on the base of given metals acetates and the acetates of metals of 1A group by decomposition in air during 5 hours by temperature 6000 °C. So we have got the oxides mixtures with the content of 1A group metals — 10, 20, 30, 40 and 50 per cent. These mixtures were the initial material for the obtained systems, by the treatment by different temperatures — 700, 800, 900, 1000 and 1200 °C.

We determined the number of «holes», corresponding to the quantity of inclusion metal of 1A group, The change of crystal lattice constant, electrical conductivity depends on the conditions to form of such systems. Fig. 1 shows the dependence of solid solution concentration on temperature of its formation. Fig. 2 shows the dependence of «hole» concentration on the initial concentration of 1A group metal (lithium).

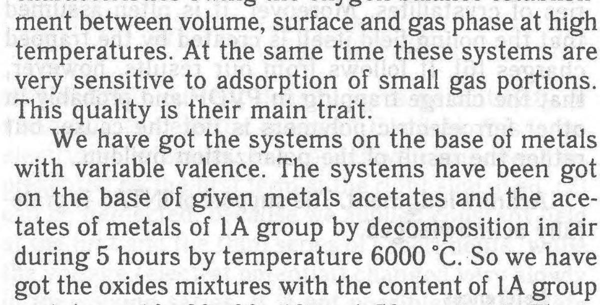

Fig. 1. Solid-solution concentration — temperature dependence. The content of 1A group metals: *1* — 10, *2* — 20, *3* — 30, *4* — 40, *5* — 50%

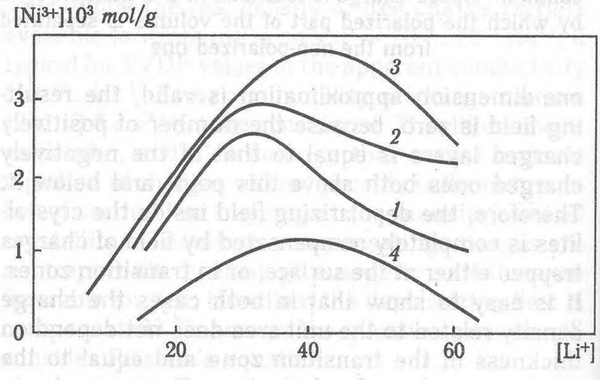

Fig. 2. «Hole» concentration — lithium concentration dependence. The temperature formation: *1* — 700, *2* — 800, *3* — 100, *4* — 1200 °C

The quantitative determination of «holes» by chemical method in solid solution consists of determination of trivalent nickel in the system. When solid solution $Li_xNi_{1-x}O$ is dissolving in the hydrochloric acid owing to oxidizing-reduction process between trivalent nickel and ion of chlorine, the uncombined chlorine is educing. The chlorine is determined by the iodometrical method. The quantity of lithium is increasing when the initial concentration is increasing.

This formula is right for all temperatures to form of solid solution. Fig. 2 shows that the curves go through the maximum (the initial concentration of lithium — at 30%) and then fall down. We have got the region where inclusion more lithium even by the way of another treatment of solid solution was impossible. The inclusion of lithium is desirable because sensor sensitivity depends on the quantity of «holes» in the system.

We can show the inner group of solid solution in mobile conduction as:

$$\left| Li{-}O^{\bullet} \begin{array}{l} \nearrow Ni^{3+} = O \\ \rightarrow Ni^{2+} = O \\ \searrow Ni^{2+} = O \end{array} \right| \leftrightarrow \left| Li{-}O^{\bullet} \begin{array}{l} \nearrow Ni^{2+} = O \\ \rightarrow Ni^{3+} = O \\ \searrow Ni^{2+} = O \end{array} \right| \leftrightarrow \left| Li{-}O^{\bullet} \begin{array}{l} \nearrow Ni^{2+} = O \\ \rightarrow Ni^{2+} = O \\ \searrow Ni^{3+} = O \end{array} \right|$$

So, sensor sensitivity is the cause of the mobility. The possibility of getting the solution by the cheap well-known methods permits the possibility of gas primary making with the help of industry. The developing ideas about «hole complex» allow us to select sensors without using the method of «tests and mistakes». The goal of this work is to research the dependence of system sensitivity Me—MeO (Me—Li, K, NA, Cs; MeO—NiO) on CO adsorption from atmosphere, draining air and nitrogen.

The films of $Me^{I}_{x}\,Me^{II}_{1-x}O$ which is on quartz plate with platinum contacts were used as sensitive substrate. The research of these pellicles shows that there is no any charges in the process of marking of solid solutions. The crystals sizes (3...10 μm) are rather the same. We carried our the experiment in gas flow containing CO (2 volume percent, T = 573 K). There is no any sharp increasing of electrical conductivity. This preparation brings to nearly full reversibility. We researched the kinetic curve of electrical conductivity $\Delta\sigma/\sigma_0 = f(t)$ and the depending of response upon the structure of solid solution and temperature of its preparation (fig. 3).

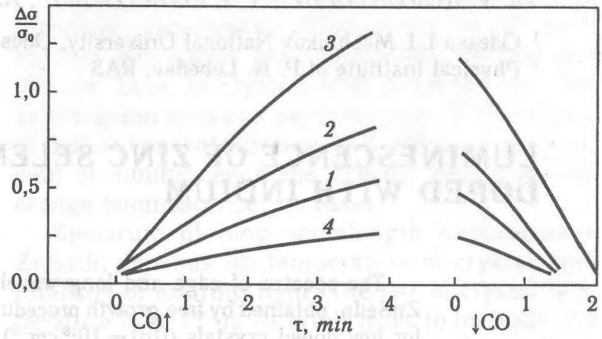

Fig. 3. Kinetic of electroconductivity. The temperature of preparation:
1 — 700, *2* — 800, *3* — 1000, *4* — 1200

The received facts are explained in terms of «hole complex».

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