chanics of Structures and Materials. 5-7 July 1993. The University of Wollongong, Vol. 2. . 673-690. Editor U.C. Schmidt // Wollongong, Australia. 1993.

3 F.K. Nihon, K. Kankyogijyutsu, Coal Ash Handbook, 4th edition, Tokyo,2005.

4 Кизильштейн Л.Я. Уголь и радиоактивность / Л.Я.Кизильштейн // Химия и жизнь, 2006. №2. С. 24-29.

УДК 539.213.2

A. E. Pochtenny, assistant professor,
V. G. Luhin, director of the Center of the physical and chemical methods of investigation, V. S. Volobuev, senior lecturer, S. S. Shikanov, student
(BSTU, Minsk)

THE ROLE OF THE ADSORBED OXYGEN AT THE CONDUCTIVITY OF INDIUM OXIDE FILMS

Thin In_2O_3 films have been received by a thermal oxidation of thin indium films, formed by a DC magnetron sputtering method. Deposition of indium films was carried out on the vacuum universal post VUP-5M. The indium films were precipitated on the single-crystal silicon wafers coated with dielectric layer epitaxial SiO_2, Al_2O_3 and muscovite mica. Indium films were oxidized in a muffle electric furnace in the non-isothermal regime: heating to a temperature of 500-600 ºC for 60 minutes and annealed in isothermal mode at 500 ºC and 600 ºC for 60 minutes. The phase structure, morphology of a surface has been investigated by methods of electron diffraction using TEM H-800 and SEM S-806. The DC conductivity of In_2O_3 films and the temperature dependence of conductivity were measured in a vacuum of 10^{-2} Pa with the aid of a V7E-42 electrometer.

The investigation was performed by method of cyclic thermal desorption based on the fact that the conductivity of In_2O_3 films depends on the concentration of adsorbed oxygen which can be decreased by heating a sample. The specific conductivity σ depends on the absolute temperature T as described by the equation

$$\sigma = \sigma_0 \exp(-E_a/kT),$$

were σ_0 is the pre-exponential factor, E_a is the conductivity activation energy, and k is the Boltzmann constant.

Analysis of electron diffraction patterns shows that the only identifiable crystal phase in the process of oxidation and in the oxide films is a cubic phase with a polycrystalline structure of In_2O_3. The indium films are characterized by grain structure with a particle size from 10 to 70 nm, the bulk (80%) accounted for the interval from 15 to 50 nm. The formation of oxide

film on a silicon substrate is accompanied by a decrease in the amount of fine particles and increased the content of particles of larger size, the bulk of which (~ 80%) are in the range of 20–55 nm, with the maximum in the range of 30–35 nm.

X-ray photoelectron spectrum of indium is characterized by the presence of two spectral lines with binding energies of 444.4 and 452 eV due to multiplet splitting of the 3d level. The chemical shift of the line In 3d5/2 in the oxide film relative to the In^0 (reference data for the average binding energy of 443.5 eV) is 0.9 eV, which can be attributed to the state of In^{3+} (change in the binding energy of the oxidation of In, In_2O_3, by reference data, is +0,8-1,2 eV).

Temperature dependence of the conductivity (Fig. 1) shows that the conductivity of indium oxide films increases as the desorption of oxygen.

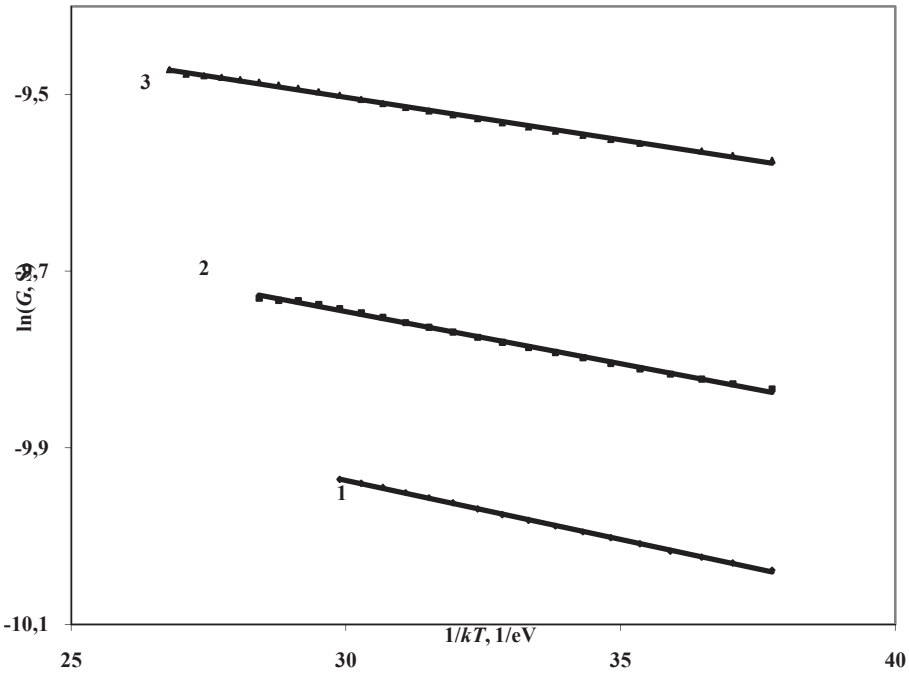

Figure.1. Temperature dependence of the conductivity of films in vacuum In_2O_3 on cooling from temperatures of 120° (1), 140° (2) and 160° C

Activation energy of conductivity is not changed and its value is set to 10 meV. Therefore, increase of conductivity, which is associated with a decrease in the concentration of adsorbed oxygen, due to the fact that oxygen is adsorbed by carrier scattering centers. Reducing its concentration results in increased charge carrier mobility. This effect could be of practical use to create adsorption-resistive oxygen sensors

The structure, phase structure, morphology of a surface and a mechanism of conductivity received films have been investigated by methods of

electron diffraction, scanning electron microscopy, X-ray photoelectron spectroscopy. The temperature dependence of the conductivity of these films was measured at a constant oxygen concentration using of the method of cyclic thermal desorption. The conduction mechanism is proposed based on the results of research. The obtained results can be used in microelectronic sensors.

This study was supported by the «Convergence» Program GB16-196.

УДК 662.754.1/3

Е.В. Билло, студ. гр. ХОБ-141, III курс;
Е.С. Сухаревская, студ. гр. ХОб-141, III курс;
А.Ю. Игнатова канд. биол. наук, доц.;
А.В. Папин, канд. техн. наук, доц.
(КузГТУ, г. Кемерово)

ПРИСАДКИ ДЛЯ ПОВЫШЕНИЯ КАЧЕСТВА ТОПЛИВА

С развитием мировой индустриализации и появлением всё большего числа промышленных предприятий возникли проблемы, связанные с загрязнением окружающей среды. Увеличение концентраций вредных веществ в атмосфере происходит за счёт увеличения отходов промышленных предприятий, а так же отработавших газов двигателей внутреннего сгорания. Ежегодно сжигание горючих ископаемых сопровождается выбросом в атмосферу 5 млрд. т. углекислого газа, содержание которого на нынешний год составляет 0,08 %.

Содержание вредных веществ в отработавших газах двигателей внутреннего сгорания зависит от загрязненности топлива. Доля загрязнения атмосферы автотранспортом составляет 39 %, эта проблема обост ı всё больше в связи с непрерывным увеличением автотранспортных средств.

В настоящее время существуют несколько альтернатив бензину – это газовое топливо и электромобили. Однако газ, в отличие от бензина, может привести к серьезному взрыву при утечке, один литр сжиженного газа при испарении превращается в 250 л газообразного. Как и газовое топливо, электромобили имеют ряд недостатков: большая стоимость электричества; короткий пробег и ограниченная скорость; большое время полной перезарядки аккумулятора; необходимость менять батарею каждые три года. Поэтому бензин на сегодняшний день является самым востребованным видом топлива.

При сгорании топлива в цилиндрах двигателей внутреннего сгорания образуются токсичные вещества – окись углерода (до 10 %), углеводороды (до 3 %), окись азота (до 0,5 %), альдегиды (до 0,03 %) и