DOI 10.1007/s10891-018-1868-y

Journal of Engineering Physics and Thermophysics, Vol. 91, No. 5, September, 2018

EFFECT OF GENERATION OF AUGER DUPLEXES

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UDC 538.91:54.057

The physical mechanism underlying the effect of generation of Auger duplexes as a consequence of the electronic level transformation in the case of local energetic effect in the atoms of complex oxides is suggested. It has been established that the effect of the formation of Auger duplexes is independent of the type of radiation acting on an object and is determined by the energy of the affecting particles and by the time of irradiation leading to accumulation of the reactions induced by electrons (ions).

Keywords: *Auger duplexes, electronic and Auger-ion spectroscopy.*

Introduction. The use of Auger-electron spectroscopy in analyzing complex objects [1–7] such as dielectrics, materials undergoing destruction on exposure to an electron or ion beam, and multicomponent materials in which the effect of selective itching or diffusion is realized, often leads to the effects of transformation (change) of spectra such as splitting, displacement over the scale of energies, and redistribution of the amplitudes of differential peaks. Until now, no clear explanation of these effects has been obtained, including the effect of the formation, in the Auger spectra, of satellite peaks, which by intensity are comparable with the basic peak or even larger than it, the so-called double peaks or Auger duplexes. In a variety of works [2–6], the results of Auger spectroscopy of various samples are given in whose Auger duplex spectra were observed.

In work [2], a model of the formation of Auger duplexes is suggested based on the assumption about the superposition of recorded Auger electrons from the atoms moving in a solid body and from the quasi-stationary atoms of the lattice of analyzed material exposed to the action of ion flow. In the opinion of the authors, the ion–atom interaction leads to the breaking of the material structure, which in turn leads to a change in the energy state of atoms, among which atoms in a state far from equilibrium appear. Moreover, in the case of ion irradiation, some of low-energy peaks had peaks-satellites (duplexes), whereas in the case of electron irradiation of the same samples, Auger duplexes were absent. The authors assumed that the formation of Auger duplexes was associated with the change in the interplanar spaces. But an experiment with mechanical deformation of monoelemental materials at a pressure of $7.5 \cdot 10^3$ kg/cm^2 has not revealed any differences in the spectra on ionic and electronic excitation. According to the authors, the energy of a particle of the affecting radiation (or of recoil atoms) leads not only to ionization of the internal shell of the atom, but is also spent on translational motion (shift) of the analyzed atom. The retardation time of such an atom is 10^{-10}–10^{-12} s, i.e., much higher than the characteristic times of Auger transitions. Consequently, the detected Auger electrons are generated from the atoms moving in a solid body. The appearance of wide spectral bands is due to the Auger transitions proceeding before the colliding particles had time to separate (quasi-molecular transitions). The formation of Auger duplexes is directly attributed by the authors to the ion bombardment and to the effect solely characteristic of it.

Work [3] presents examples of recorded "unidentified" peaks of Auger electrons after a high-energy effect exerted on samples. In [4, 5], the formation of Auger duplexes is explained by the relaxation of ions sputtered from the surface, and in [6], by the channeling effect. In work [7, p. 494], a general recommendation is given to reduce the quantity of reactions induced by bombarding electrons and, as a consequence, to reduce the artefacts of the analysis by using affecting low-energy electrons.

The purpose of the present work is to study the characteristic features of the effect of generation of Auger duplexes of oxygen on the basis of the results of experimental investigations of small-size particles exposed to the action of a different-energy electron probe.

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