The moving lines of electron spectra: emergence or artifact?

As known, positions and specific shapes of spectral lines characterize a nature and properties of chemical elements and their compounds. But what is meaning a changeable position of any spectral line? When some lines displace continuously within the spectrum?

A review “The moving lines on electron spectra as charge reflexes on non-equilibrium states of nanostructured surfaces” is published recently in Nanoscale Research Letters (SpringerOpen, 2016). This article is dedicated to analyze the “strange charge lines” in secondary electron emission spectra for materials which have changeable surface structure induced by electron probe. The new results of experimental investigations by the methods of scanning electron microscopy and Auger electron spectroscopy and theoretical considerations reflect an emergent effect of largest interatomic shifting between discrete electron stages in interfaces. This effect is linked spatially and in time with spontaneous processes of surface producing in the ionized interfaces.

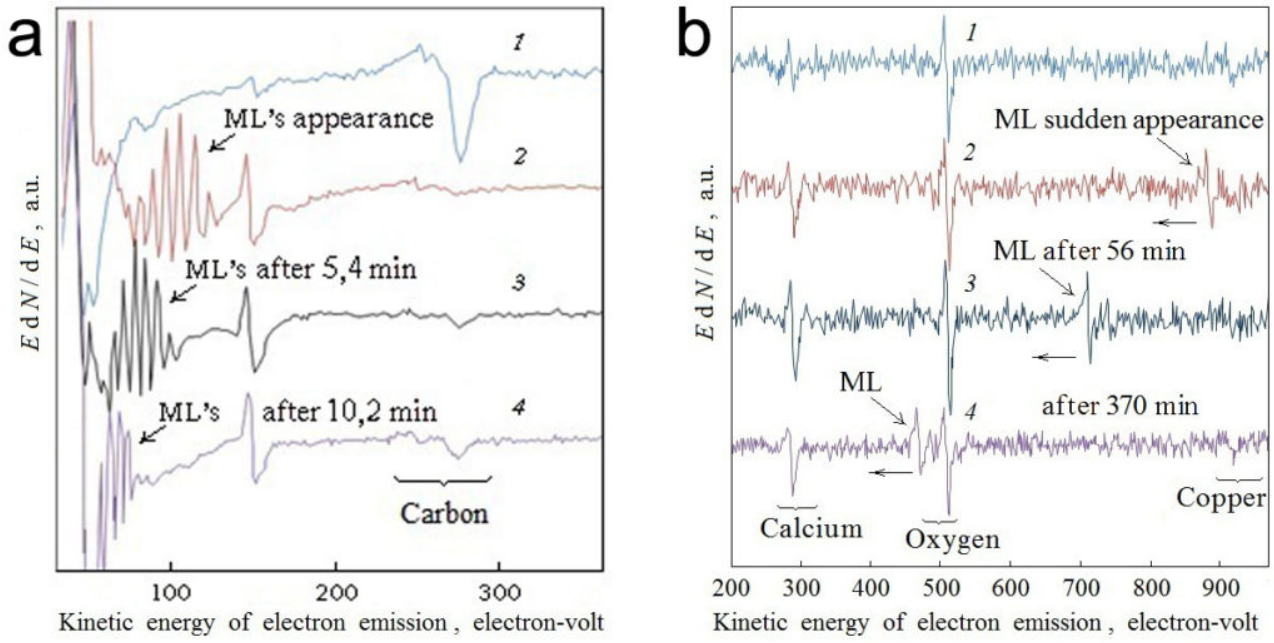

Fig. 1. A soliton-like complex of moving lines (ML’s) induced by intense probe impact on thin organics-oxide-metal layers on substrate (a), and a spontaneous soliton-like moving line (ML) for high-temperature superconductive BiSrCaCuO ceramics (b). There are prelaunch surface state, 1; initial appearance of moving lines, 2; their displacements and changes in times, 3 and 4. Adopted from Mishchuk (Nanoscale Research Letters, 2016)

A soliton-like moving line or a complex of a few ones appears as a long-term dynamic feature in secondary electron spectra (Fig. 1). After initial appearance in any region of spectrum moving lines

displace along them within a very large energy range of several tens (*a*) and even hundreds (*b*) electron-volts during long enough time. Simultaneously positions for known spectral lines of elements (carbon, copper, oxygen, calcium, etc.) remain stable.

What are these moving lines on electron spectra? Is it a new effect of emergence or old analyzer artifact?

Electric fields may present between the sample and the analyzer of secondary electrons, and the phenomenon of moving lines is unknown in scientific literature. So, such events may consider as harmful experimental artifacts in electron spectroscopy.

Similar insights includes any answer on a native question “Why is that the regularities of moving line manifestations which have place often for ordinary electron probe analysis of non-stable materials, are researched dimly for our days?’

Nevertheless, non-ordinary “charge” lines on electron spectra are not spurious and may indicate about charge-induced hidden processes within interfaces. Physical causes and micro-mechanisms for moving line appearance-disappearance as an emergent spectral feature and moving line continuous displacement on the spectra as a charge reflex on the interface restructuration must be mutually connected, but are different.

A wider analysis of physical events allows better understand a complex nature of the moving line phenomenon and its connections with others. In some spectral aspects (soliton-like form, etc.) the moving lines are similar to experimental revelation of electron orbit collapse in atoms founded by Molodtsov et al. (Physical Review, 1994) with the reverse photoelectron spectroscopy. Especially this is close to the giant resonances within bremsstrahlung spectra observed by Liefeld, Burr, and Chamberlain (Physical Review, 1974). In both cases we analyze the energy of secondary x-rays which are induced by electron flow but don’t have electrical charges themselves. So, for atomic clusters in ionized interfaces the electron collapse stage induced by incident electron probe and local surface charges can be seen as realistic reasons for ‘switching’ and supporting of the ‘moving line’ processes.

Presented results and presumable mechanisms of a phenomenon are not ending but, rather, are intended to focus on the effect and illustrate it in general. More detailed physical nature of the moving lines remains still debatable.

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