Non-radioactive electron source for atmospheric pressure ionization

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Synopsis We present electron source for atmospheric pressure ionization (API). In present study we have focused on the characterization of the electron source, its electron energy distributions function (EEDF) after transition through Si_3N_4 membrane. EEDF's were measured for different initial kinetic energies and for different membranes modifications.

Recently, electron guns with nano-membrane vacuum-atmosphere interface (window) of 300 nm thickness were reported, applicable for transport of keV electrons from vacuum to atmosphere [1-3]. Such electron sources are suitable replacements for radioactive ion sources based on β radiation and could be applied for Atmospheric Pressure Ionization (API) in Mass Spectrometry (MS) and Ion Mobility Spectrometry (IMS) or other analytical methods at atmospheric pressure (e.g. excitation fluorescence) [4].

In this work we present results of recent studies involving measurements of EEDF after transition through ceramic Si_3N_4 window as a function of initial kinetic energy of electrons. The measurements were carried out for three different windows modifications of the same 100 nm Si_3N_4 membrane (pure or plated by gold layer of 2.5 or 5 nm thickness). The experimental apparatus consisted of the electron source and the cylindrical energy analyzer.

The Fig. 1 shows dependence of the relative average electron energy (ratio of average electron energy after transition through the membrane to the initial electron energy before membrane) as a function of the initial electron energy. These functions were measured for pure and gold-plated Si_3N_4 windows of 100 nm thickness. Gold plating of the windows result in increase of the average energy of transmitted electrons at arbitrary initial electron energy. We attribute this behavior to the removal of the Si_3N_4 windows charge in the case of gold plated windows. In the case of pure Si_3N_4 window the surface charge produced on the surface of the windows decreases the kinetic energy of the electrons transmitted through the windows [5].

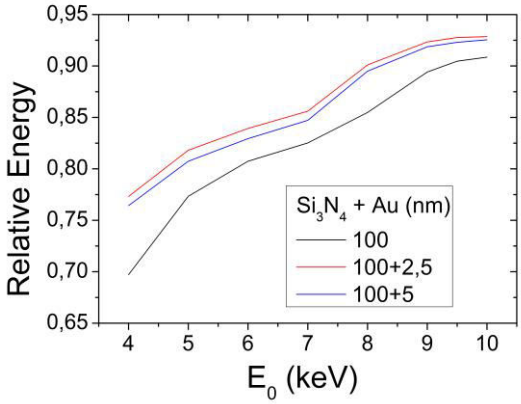

Figure 1. The average electron kinetic energies after transition through various Si_3N_4 windows as a function of the initial electron energy.

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