LOW-ENERGY ELECTRON ACCELERATORS AND SOURCES WITH PLASMA EMITTERS FOR SCIENTIFIC AND TECHNOLOGICAL PURPOSES

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At present, low-energy sources (up to 30 keV) and accelerators (up to 200 keV) of electrons find wide practical and scientific use and have a wide range of parameters of the generated electron beam, which is determined by the problem being solved. Thus, electron sources can also be used for processing various organic materials (polymers, gases, food or medical products, etc.) [1–8], generating beams with a relatively low energy density, most often outputted into the atmosphere through an output foil window, or for processing various inorganic (metallic and cermet) materials in vacuum in order to change the functional and operational properties of their surface [9–12]. Such problems can be rationally solved using sources of electrons with plasma emitters based on arc or glow discharges. The work will consider three systems, each of which is unique in terms of a set of basic parameters, namely:

1) Low-energy source of electrons "SOLO" (Fig. 1), which allows generating a wide intense electron beam of submillisecond duration for the implementation of the purposes of pulsed modification of the surface of metallic materials and simulation of extreme thermal effects. Beam parameters: electron energy up to 30 keV, beam current up to 500 A, pulse duration up to 1 ms, pulse repetition rate up to 10 s^{-1}, beam diameter up to 5 cm). The source has the ability to control the beam power, based on the unique property of sources with plasma cathodes, which consists in a weak dependence of the parameters of the generated electron beam from each other, which makes it possible to control the rate of energy input into the surface of the metal material, and, in particular, the temperature of this surface, which can be extremely important in the implementation of a scientific search for the optimal exposure regime.

2) Low-energy electron accelerator "DUET", which generates a beam of large cross-section (≈1000 cm^2) with its extraction into the atmosphere or high-pressure gas. This electron accelerator operates in a repetitively pulsed mode (electron energy up to 200 keV, beam current up to 50 A, pulse duration up to 100 μs, pulse repetition rate up to 50 s^{-1}) and can be used to solve environmental problems (dioxin-free conversion of polyvinyl chloride into carbon films), chemically pure modification of the properties of natural latex, utilization of gaseous silicon tetrafluoride to obtain pure silicon at the output, in the agricultural field for disinsection, disinfection and growth stimulation, for example, cereals, etc. One of the unique features of the accelerator, in addition to the range of parameters of the generated beam, is the ability to control the width of the energy spectrum of the beam ejected into the atmosphere, which determines the depth of passage of an electron in matter (liquids, gases, polymeric materials, etc.) can be an extremely important factor in solving various technological tasks.

3) Low-energy electron accelerator "HELION", the principle of operation of which is based on ion-electron emission, which generates a beam of large cross-section (≈3000 cm2) with its outputting into the atmosphere or high-pressure gas. Unlike the DUET accelerator, the HELION accelerator has a constant generated electron beam current (electron energy up to 160 keV, beam current up to 100 mA), but it can be used to solve problems similar to the DUET accelerator. "HELION" has a simpler design, smaller weight and dimensions, as well as a longer service life of the high-voltage cathode, which is a metal plate. A method for high-frequency (tens of kilohertz) generation of an auxiliary discharge generating emission plasma, and, accordingly, high-frequency generation of an electron beam of the same frequency, ejected into the atmosphere, is demonstrated.

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