
# Advances in development new generation plasma-optical systems


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## ABSTRACT

**We describe recent developments of novel plasma-optical systems. For the first time we consider a combined system including a MEVVA plasma source with a cylindrical electrostatic plasma-optical lens. This combined system is of fundamental interest and could be attractive for a number of practical applications. The system can be used for effective repetitively pulsed, high current, moderate energy plasma sources of heavy metal ions and electrons. The hardware is interesting for high productivity technological equipment using relatively pure plasma flow for the synthesis of fine coatings and thin films. We have studied the plasma-dynamic characteristics of high density plasma flow propagating through the plasma lens, the optical spectra and the charge state distribution, as a function of different experimental conditions. Application of the plasma lens to the transport of low energy high-current ion beams can improve the delivery of plasma to a substrate, as well as providing micro-droplet evaporation and elimination due to the presence of fast electrons within the lens region. Here we consider mainly the transport aspects, as well as the effect of fast electrons on the characteristics of low energy ion plasma beams.**


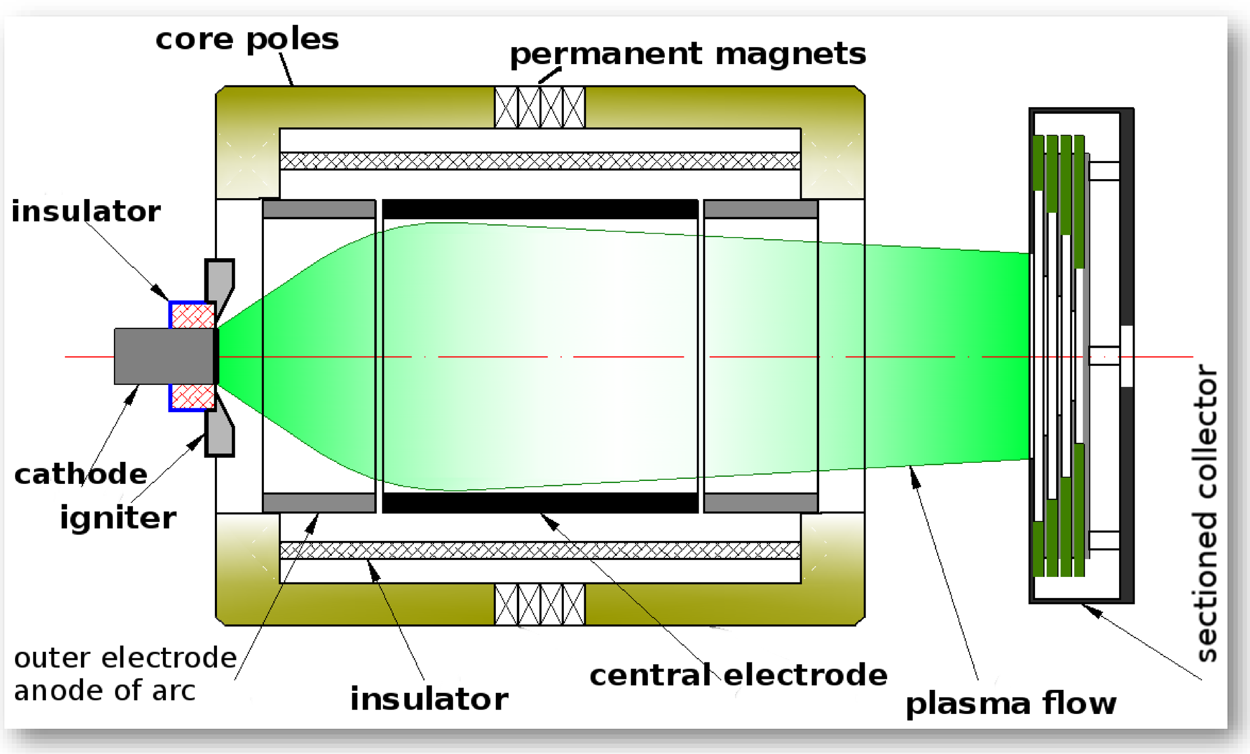


**FIGURE 1.** Schematic of the main parts of combined experimental device.

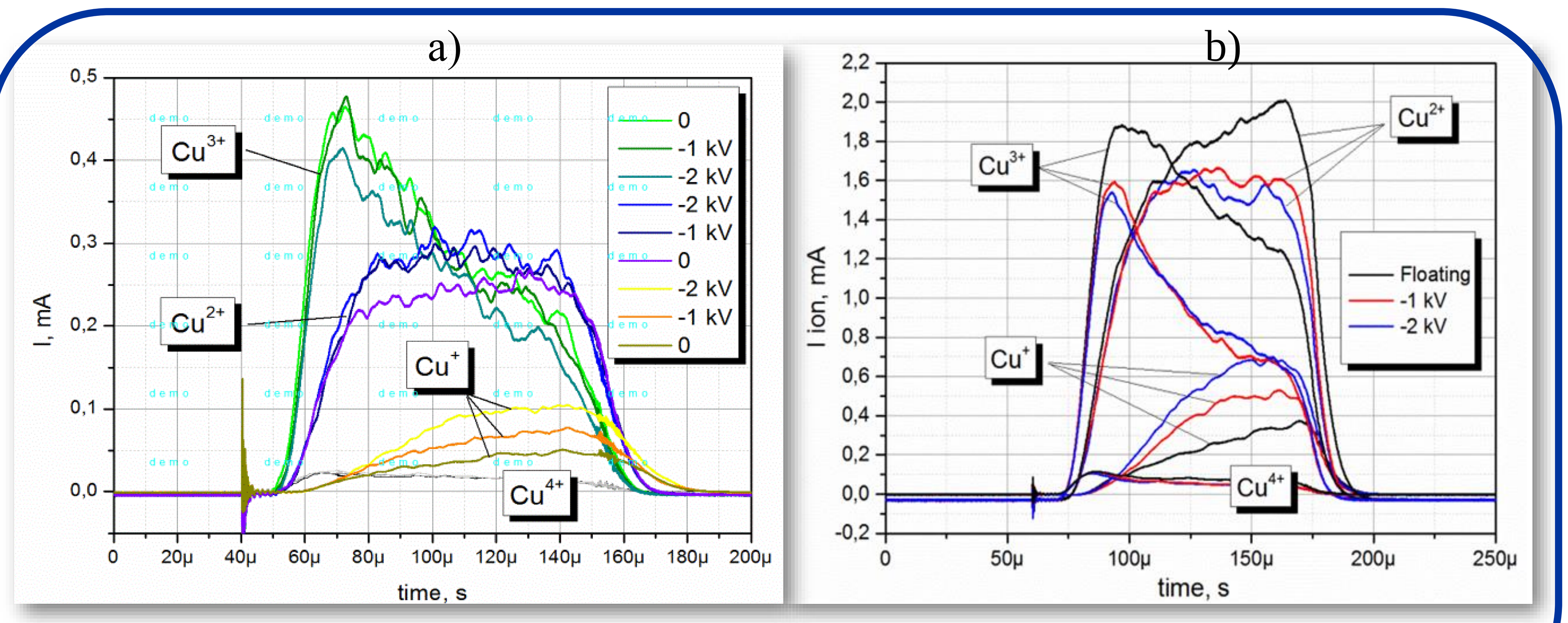


**FIGURE 2.** Charge state distribution of Cu ions, p= 1.5 × $10^{-6}$Torr, B=0 (a) and B=0.03T (b).

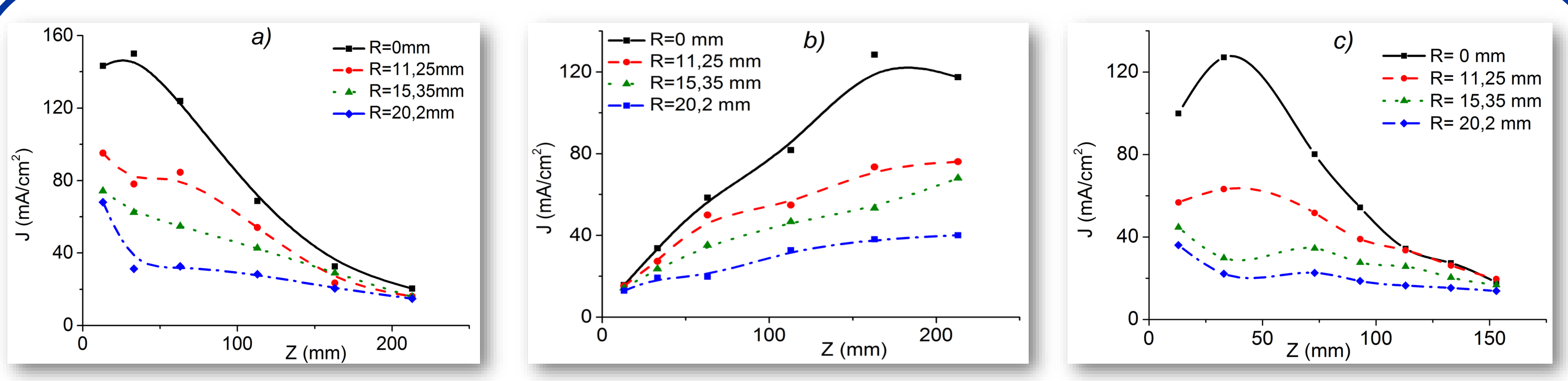


**FIGURE 3.** Plasma ion current density as a function of distance from the lens exit plane for ring-shaped collectors with different value radius and different central lens electrode potentials: (a) negative -400V, (b) positive +50V at floating (c). $I_d$ = 100 A, P= 1.5*$10^{-6}$ Torr, B = 0.03T throughout the plasma pulse.

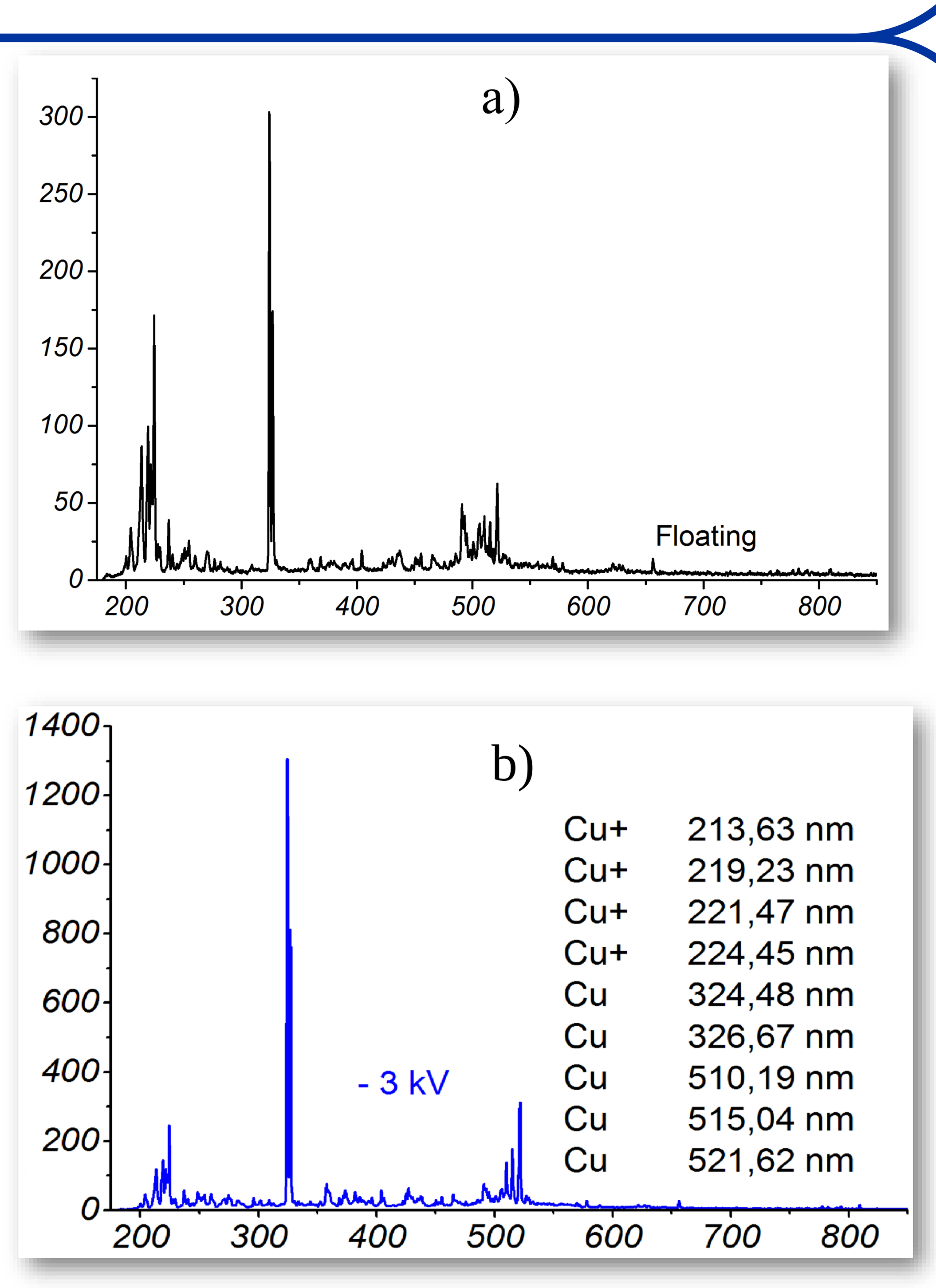


**FIGURE 4.** Optical emission spectra of the discharge plasma in arbitrary units for different central lens electrode potentials: a) floating, b) –3kV. B = 0.03T, pressure 1.5*$10^{-6}$ Torr.

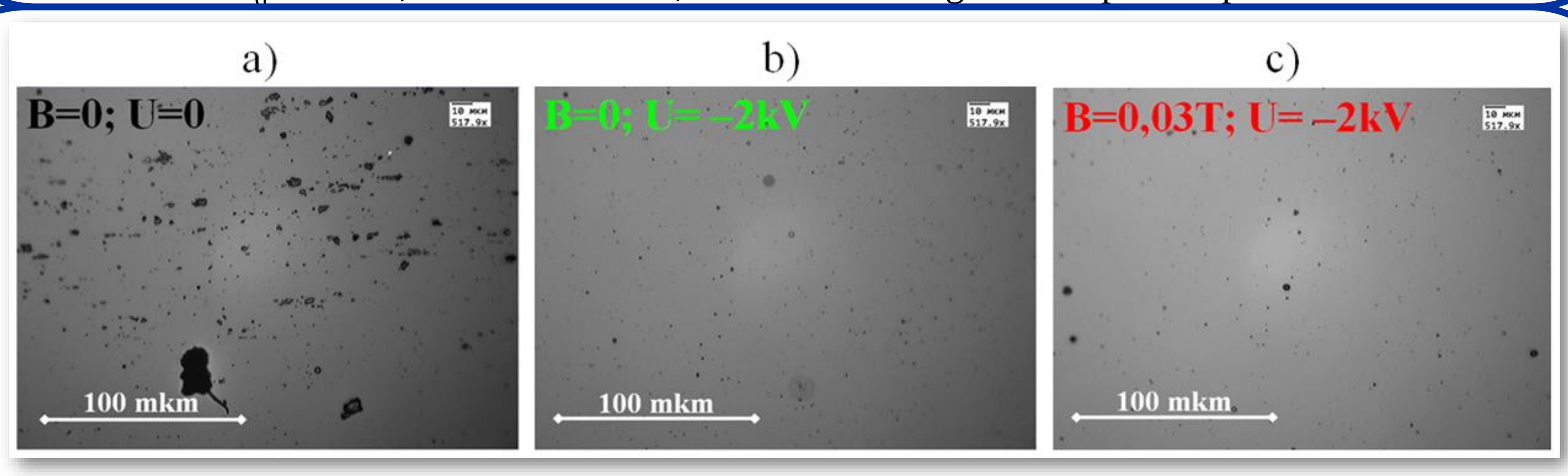


**FIGURE 5.** State of the surface in case of film deposition for different operating modes: a) without filter, b) no magnetic field (B=0), central electrode potential U= –2kV, c) B=0.03T, U= –2kV

## CONCLUSIONS

**New combined system including MEVVA source with axi-symmetric electrostatic plasma-optical lens (PL) is presented. Peculiarities of plasmadynamical, optical, charge state characteristics, pictures of Cu deposition indicating the presence of fast electrons and their effect on high density plasma flow propagating through PL are studied. The presence of fast electrons in the volume of the PL both improves the propagating ion plasma flow towards the substrate and introduces additional energy for effective evaporation of micro-droplets from the plasma flow. These results open up new attractive ways for further development and application erosion plasma sources.**

## REFERENCES


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