

INJECTION OF CHARGED PARTICLES IN A BREAKDOWN OF A METAL–DIELECTRIC–METAL SYSTEM

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On strong heating of a metal by a current passing through it, vaporous plasma comprising mostly ions and electrons is formed. It can be used as a source of charged particles. Thus, explosion of cathode microtips was first initiated by a field emission current and then by a thermal field emission current of huge density [1]. This emission was called explosive and provided the basis for the development of superhigh-power electrical equipment systems. Explosion was also initiated by a high-current pulse passing through a thin (explosive) wire [2]. Explosion of substances in dielectric breakdown of a metal-dielectric-metal (MDM) system has been initiated quite recently [3]. In this case, the current passed through the upper electrode, dielectric, and the lower electrode. Materials of these parts of the MDM system evaporated, the dielectric dissociated, and as a result, plasma was formed. Figure 1 shows a scheme of the experiment on measuring currents.

A positive or negative potential was applied to the metal electrode located above the MDM system. With the positive potential, the electron current up to a few tens of amperes was generated. With the negative potential, positively ionized atoms and currents up to 100 mA were recorded on the collector. The indicated charged particle emission [3] differed from the explosive emission [1].

In the first case, the plasma was initiated with a dielectric breakdown in the MDM system [3]. In the case of explosive emission [1], the plasma was initiated with field emission and then with thermal field emission. An advantage of the method of electron and ion emission is a low voltage (a few tens of volts) and sufficiently high current densities. Therefore, charged particle beams are more easily focused. The phenomenon of the breakdown of the MDM system and the electron and ion plasma initiation with possible extraction of plasma electrons and ions can be useful for the development of new technologies in microelectronics.

REFERENCES

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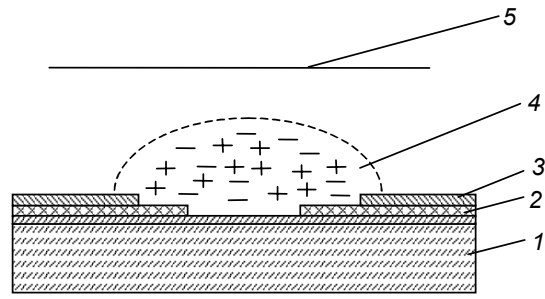


Fig. 1. Scheme of the experiment on charged particle injection in breakdown of the MDM system comprising substrate with the lower electrode 1, dielectric 2, upper electrode 3, plasma cloud 4, and collector 5.