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Electric field on the surface of a metal electrode with dielectric film in plasma

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The calculation of the electric field on the surface of a metal electrode coated with a continuous dielectric film and immersed in plasma, at a negative electrode potential Ψ***, when the parameter*** $e\Psi$ ***significantly exceeds the electron temperature*** T_e ***(***$\frac{e\Psi}{T_e} \gg 1$***), has been carried out. It has been established that as a result of charging the outer surface of a film 10–1000 nm thick with a flow of positive ions from the plasma, a strong electric field arises inside the film, the magnitude of which can reach values of 1–10 MV/cm at a plasma density of*** 10^{12}***–***10^{13} ***cm***$^{-3}$ ***and electron temperature*** $T_e = 10$ ***eV.***

In breaks in the dielectric film, the magnitude of the electric field is comparable to the magnitude of the field inside the film. On the surface of a dielectric film and on a clean metal surface without a film, the magnitude of the electric field in the plasma is significantly less than the fields inside the film. Strong electric fields inside the film and in its breaks can lead to electrical breakdown inside the film or in its breaks. Electrical breakdown of a dielectric film can initiate unipolar arcs on metals, excite microplasma discharges and form centers of explosive electron emission on the surface of metals in plasma.

Keywords: metal electrode, dielectric film, plasma, electric field, electrical breakdown of a film.

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