

Mathematical modeling of RF plasma flow at low pressures taking into account the charge on the sample

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RF plasma at low pressures ($p = 13.3 - 133$ Pa) with gas flow is effectively used for modifying the surfaces of materials of organic and inorganic nature [1]. This type of plasma has the following properties: degree of ionization is 10^{-4} - 10^{-7} , electron density is 10^{15} — 10^{19} m⁻³, the electron temperature is 1—4 eV, the temperature of the atoms and ions in the bunch $(3 - 4) \times 10^3$ K in the plasma jet $(3.2 - 10) \times 10^2$ K. The main feature of RF plasma flow at low pressure is that for neutral component plasma flows in a transitional mode between the continuum mode and free-molecule flow, the charged components can be approximated of continuous medium [2,3]. Mathematical model of RF plasma flow at low pressure taking into account the charge on the sample is constructed. Calculations of the main parameters of RF plasma at low pressure are completed, influence of electromagnetic field in vacuum chamber with sample is investigated. The reported study was funded by Russian Science Foundation, according to the research project No. 19-71-10055.

- [1] Abdullin I S, Zheltukhin V S, Sagbiyev I R and Shayekhov M F 2007 *Modifikatsiya nanosloev v vysokochastotnoj plazme ponizhennogo davleniya* (Kazan: Izdatel'stvo Kazanskogo tekhnologicheskogo universiteta)
- [2] Zheltukhin V S and Shemakhin A Y *Mathematical models and computer simulations* **6** 101
- [3] Zheltukhin V and Shemakhin A Y 2019 Mathematical modelling of rf plasma flow at low pressure with metastable and electrodynamics *Journal of Physics: Conference Series* vol 1158 p 042044