# MASS DISTRIBUTION OF SPUTTERED CATHODE MATERIAL IN THE REFLEX DISCHARGE ALONG THE MAGNETIC FIELD MIRROR CONFIGURATION

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The paper is concerned with the distribution of cathode material sputtered under the action of the pulsed reflex discharge plasma and deposited on the anode surface (vacuum chamber) by means of a set of discrete receiving plates. Correlative relationship has been found between the weight gain increase of the receiving plates due to the deposition of cathode material (Ti) particles on them and the increasing magnetic field regions. The maximum possible sputtering yield $Y_{curr}$ has been evaluated. The authors have deduced parametric dependences of the sputtering ratio on the power function exponent that determines the shape of the radial plasma-density profile, and also, on the magnetic field induction value.

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## INTRODUCTION

The problem of testing by experiment the patented method of supplying the working (separable) substance in the separating magnetoplasma device has been solved previously [1–3] on the basis of the reflex discharge. It has been demonstrated that the sputtering mechanism of working substance supply is sufficiently efficient to provide the plasma of density ~ $10^{14}$ cm$^{-3}$. The measured cathode (sputtering) material yields ranged up to $2.8\cdot10^{-2}$…0.26 atoms/ion, depending on the total number of particles in the discharge. Besides, based on the experimental data, quantitative estimations have been made for the mass flow rate of the cathode material coming to the discharge due to the mechanism of working cathode surface sputtering under the action of ion flows of gaseous plasma pre-generated in the inert-gas medium (Ar and the Kr-Xe-$N_2$-$O_2$ mixture) in the pulsed reflex discharge with crossed $\boldsymbol{E}\times\boldsymbol{B}$-fields. The bulk quantity of the working substance of the discharge-generated multicomponent plasma, which is carried away across the confining magnetic field and is condensed on six receiving plates being at room temperature, has been also estimated. The data obtained in [3] have suggested a preliminary conclusion about a directional separation of the plasma heavy component as a result of centrifugal effects.

The present paper describes experimental studies into the distribution of sputtered cathode material along the long axis *z* of the facility on the inside of the vacuum chamber (anode), mainly, on the receiving plates located in the central part of the mirror-configuration magnetic system of the reflex discharge, similarly to ref. [3]. At the same time, additional data have been obtained on the dynamics of specific sputtered cathode material flows as functions of the initial discharge formation conditions, in particular, gas composition of the discharge, cathode working surface condition, and efficient sputtering ratios.

Thus, relying on the obtained experimental data, the goal of this work has been to make up and analyze the estimated weight balance of the cathode substance coming to the discharge, with due regard for the changed initial conditions of the discharge formation. In this case, the total weight balance of the cathode material takes into account not only its distribution on the receiving plates, but also on the vacuum chamber walls.

## 1. EXPERIMENTAL SETUP

The experiments were performed on the MAKET setup providing a pulsed reflex discharge in a longitudinal magnetic field of mirror configuration (for more details see refs. [3–6]). The experimental conditions were as follows:

– residual chamber pressure was $1.33\cdot10^{-4}$ Pa; then the discharge ignition gas (Ar, air) was let in the chamber up to a pressure of 0.133 to 4.7 Pa;

– cathodes, 4 mm in thickness and 100 mm in diameter, were made from titanium;

– the working Ti cathode surfaces were exposed to the plasma of density $\leq 2\cdot10^{14}$ cm$^{-3}$, generated in the reflex discharge at normal operation conditions: discharge voltage $\leq 4.6$ kV, discharge current $\leq 2$ kA, magnetic induction $\leq 0.4$ T, plasma pulse length up to 5 ms;

– in the middle part of the magnetic system (Fig. 1), between the diagnostic ports *a-a* and *b-b*, 20 receiving plates were placed to collect the plasma metal component particles leaving the discharge across the magnetic field;

– the receiving plates, made from copper, measured 12x32 mm;

– the total number of pulses applied for sputtering the cathode material with subsequent sputtered particle deposition on the receiving plates amounted to 4006; of which, 72 pulses (1.8% of the total number) were performed in the air atmosphere, and the rest, i. e., 3934 pulses (98.2%) were realized in the Ar atmosphere.

The cathode/receiving plate mass before and after plasma treatment was determined through weighing with the use of laboratory balance of Type VLR-200 g. The surfaces of the cathode and the receiving plates were examined by means of the interference microscope MII-4.

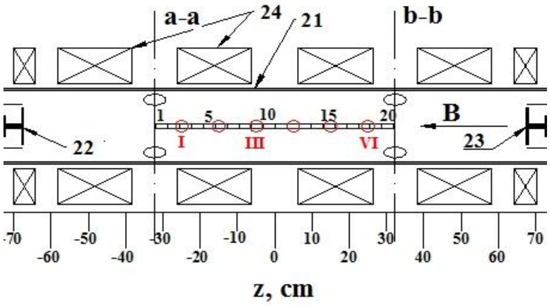



*Fig. 1. Schematic view of the MAKET setup and the arrangement of receiving plates (top view): 1 to 20 – receiving plates; 21 – discharge chamber (anode); 22 – cathode No 1; 23 – cathode No 2; 24 – magnetic system; a-a, b-b – diagnostic port cross-sections; I-VI – arrangement of receiving plates in [3]*

## 2. EXPERIMENTAL RESULTS AND DISCUSSION

Fig. 2 shows the photos of the Ti cathodes before and after plasma treatment (×500 magnification). As is seen from Fig. 2,c,d, the cathode surface exhibits the traces of material erosion. In this particular case, unlike the results obtained in [3], there are no traces of partial surface fusion of the cathode. For comparison, Fig. 3 shows the photo of the Ti cathode surface (×500) after the action of the cathode spot of the stationary vacuum arc (arc current 100 A, voltage 27 V), where the traces of Ti surface fusion are clearly seen. Therefore, the previously observed partial cathode surface fusion [3] is evidently due to the transition of the reflex discharge to the arcing mode, reported earlier in [7]. The absence of cathode fusion marks in the present experiments (see Fig. 2,c,d) apparently testifies to the reduction of discharge transitions to the arcing mode [7].

Table 1 lists weight characteristics of Ti cathodes before and after the treatment. As is seen from the table, the titanium cathodes are characterized by different losses in weight. For example, the loss in weight by cathode No 1, located above the vacuum scavenge pump, was found to be 497.6 mg for the whole operating period. Cathode No 2, remote from the exhaust unit, lost in weight 347.2 mg, this being ~ 30% less than in case of cathode No 1. Considering the total cathode material loss in weight (see Table 1), the specific flow of the sputtered matter can be estimated to be 0.211 mg/pulse or 0.26 mg/(cm$^2$·s). Table 2 gives the experimental data on the specific sputtered-matter flows obtained in this work and the ones presented in ref. [3]. It can be seen from Table 2 that the specific sputter-matter flow estimated in the present work is by a factor of 2.15 less than that indicated in [3]. This may be attributed to the difference between the initial conditions of work [3] and of the present experiments, namely, the percentage ratio of the pulses realized in a certain gas atmosphere to the total number of pulses. As is known [8], the sputtering ratio depends on the atomic weight of ions, the ion energy and the angle of ion incidence on the sputtered surface. On the other hand, in work [3], the areas of fused cathode surface were observed, that resulted in an additional mass outflow of the cathode material.

Table 1

| No | Initial mass, g | Final mass, g | Δm, g |
|---|---|---|---|
| 1 | 147.2244 | 146.7268 | -0.4976 |
| 2 | 146.3217 | 145.9745 | -0.3472 |
| | | | $\sum$= -0.8448 |
| | | | $\Delta\overline{m}$ = -0.4224 |

Table 2

| Parameters | [3] | Present work |
|---|---|---|
| Sputtered matter | Ti | Ti |
| Total number of pulses | 3446 | 4006 |
| Percent of the total number of pulses | 90.16 (Ar)<br>9.84 (Kr-Xe-$N_2$-$O_2$) | 98.2 (Ar)<br>1.8 (air) |
| Specific flows of sputtered matter, mg/(cm$^2$·s) | 0.56 | 0.26 |

In the plasma-solid surface interaction, a variety of processes such as electron emission at particle interaction with the surface, sputtering, blistering, etc., take place [8]. One of the main processes that causes the cathode material damage, and hence, its ingress to the plasma, is sputtering.

Experimental studies of cathode sputtering in the reflex discharge were carried out in a number of works [9–15]. The authors of refs. [9–12] have investigated the cathode sputtering ratios for a number of metals at low gas pressures $P \leq 4.4\cdot10^{-2}$ Pa, when the mean free path of sputtered atoms $\lambda$ was greater than the discharge gap size. At those conditions, some special features of cathode sputtering in the reflex discharge were observed [9–12]:

– the effective cathode sputtering yield $Y_{curr}$ is nonuniformly distributed on the radius of the cathode and decreases from the center to the periphery; it is also dependent on the discharge parameters ($P$ – pressure, $B$ – magnetic field induction, $V_a$ – anode voltage). With increase in $B$ and decrease in $P$, the region of high $Y_{curr}(r)$ values shifts from the center to the medium regions of the cathode;

– the nonuniformity of the $Y_{curr}=f(r)$ distribution and its absolute value increase with an increasing mass of bombarding ions, this being due to the increase in the momentum transferred by the ion in consequence of its mass and energy increase, which is associated with the change of the potential distribution in the discharge gap;

– a portion of the sputtered metal from the central part of one of the cathodes falls on the opposite cathode.

The erosion behavior of the cathodes during their interaction with a stationary low-temperature weakly ionized plasma of the reflex discharge has been investigated for different metals in refs. [13–15]. Under conditions of a weakly ionized plasma at pressures $P \geq 1.8\cdot10^{-1}$ Pa, the cathode sputtering occurs not only due to the ions of the gas component, but also may be due to the ions of the cathode material, i. e., self-sputtering may take place [13].

The interaction of the cathodes with dense plasma from the pulsed reflex charge has been investigated in the earlier cited papers [2, 3], and also in [16], where the exposure of the beryllium target to $H_2$ plasma flows gave rise to blistering on its surface.

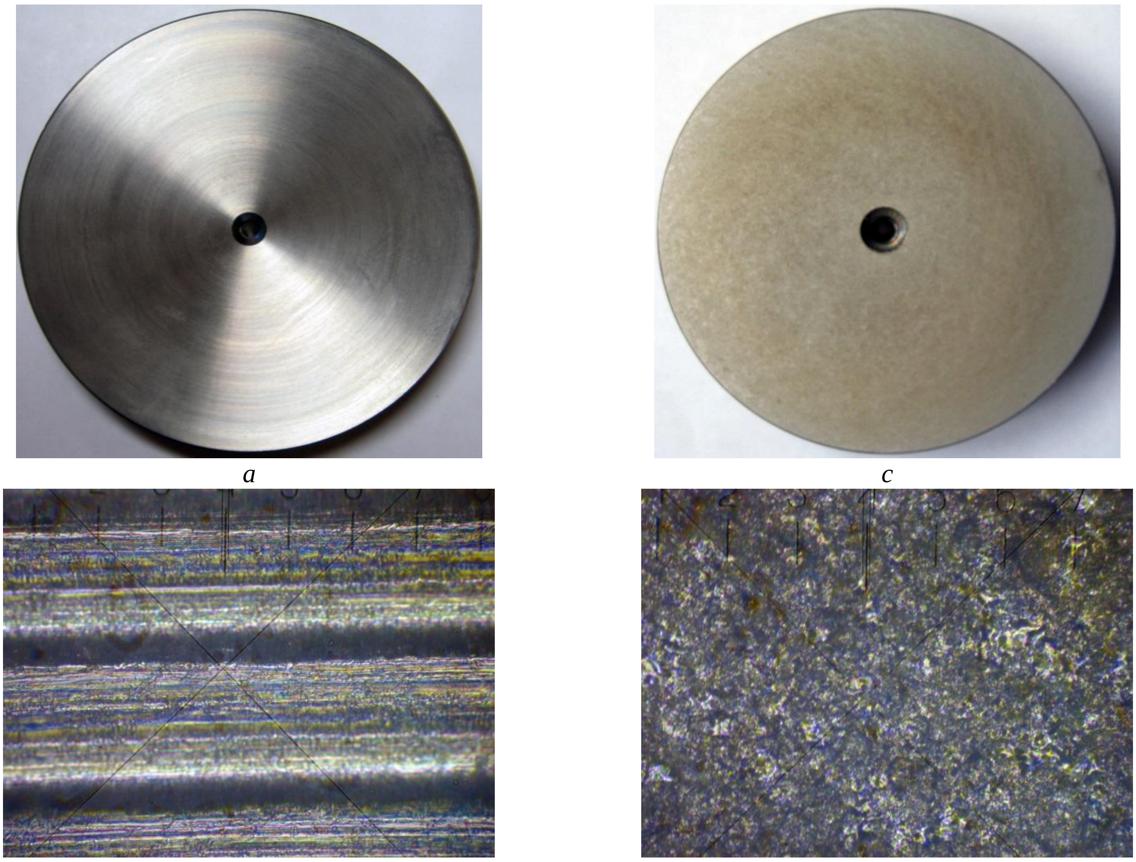



*Fig. 2. Photos of the cathodes (a, c) and the magnified (×500) images of their surface areas (b, d), before (a, b) and after (c, d) plasma treatment*

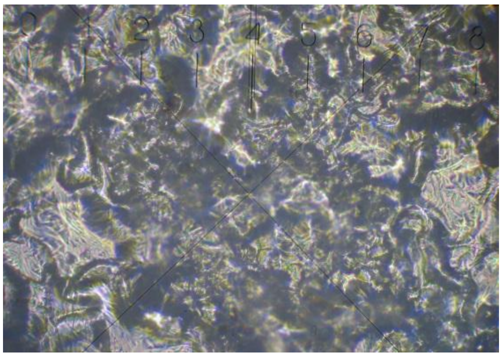


*Fig. 3. Titanium cathode surface after exposure to the cathode spot of the stationary vacuum arc (×500)*

In the present studies, it is essential to note the possibility and necessity of estimating the actual cathode sputtering ratio under conditions of the reflex charge. As in ref. [2], it appears possible to estimate the highest possible (at the given experimental conditions) sputtering ratio in terms of the ratio of the number of particles coming to the discharge to the number of particles participating in the sputtering process on the part of the discharge plasma. In our case, it was expected to be ~ 1.0. Its running values as functions of some discharge parameters, viz., the index of power in the equation of radial plasma density distribution:

$$N(r) = N_{\max}\left[1-\left(\frac{r}{r_{\max}}\right)^{\gamma}\right], \qquad (1)$$

and the magnetic field induction, are presented in Figs. 4 and 5. The maximum sputtering ratio values are attained in the case of a uniform plasma density profile, as in [17], i. e., at the power function exponent in eq. (1) $\gamma \geq 8$. The increase of the function $Y_{curr}=f(B)$ is determined by the fact (evidenced by experiments) that the radial plasma density profile changes with a varying magnetic field value in such a way that with the field increase the radius at $N_e=N_{cr}$ also increases. The reason is that with the magnetic field increase the diffusion flows across the magnetic field decrease. The obtained results are in satisfactory agreement with the literature data [2, 18].

Let us next consider the distribution of the cathode material deposited on the receiving plates. Fig. 6 shows the photos of the plates before and after sputtering. The surface color difference of the receiving plates (yellow-red – prior to sputtering, white – after sputtering) is indicative of the cathode material deposition on their surfaces during sputtering.

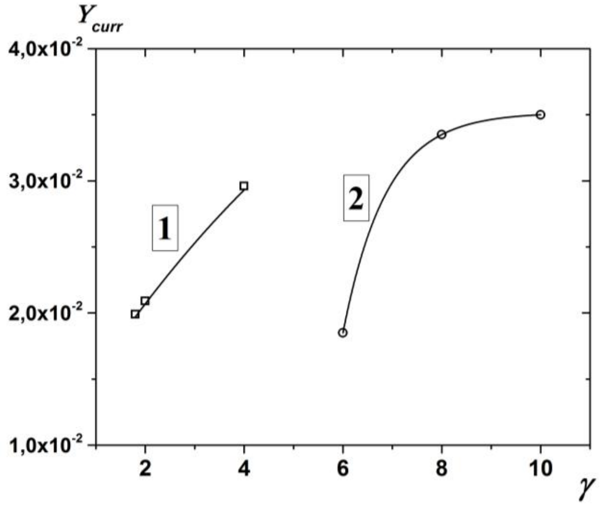



*Fig. 4. Sputtering yield $Y_{curr}$ versus the power function exponent, which determines the shape of the radial plasma density profile ($N_e$=1.7·10$^{13}$ cm$^{-3}$, P=0.267 Pa, $U_{dis}$=3.2…3.8 kV): 1 – $U_в$=0.7 кV, B=0.18 T; 2 – $U_в$=1.5 кV, B=0.375 T*

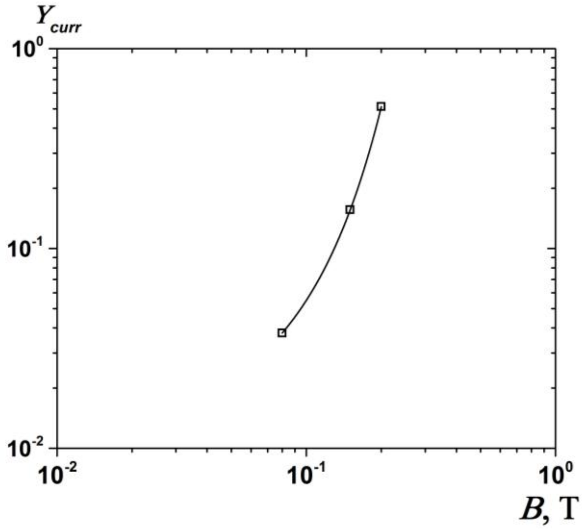
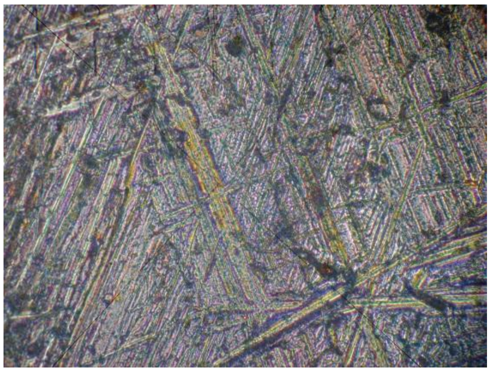



*Fig. 5. Sputtering yield $Y_{curr}$ versus magnetic field induction ($N_e$=2·10$^{14}$ cm$^{-3}$, P=0.8 Pa, $U_{dis}$=3.8 kV, γ=4)*

Fig. 7 shows the diagram of weight gain by the receiving plates. The registered values for plates No 4 (*Δm* = 0 mg), No 5 (*Δm* = 100 mg), No 10 (*Δm* = -0.15 mg) were not taken into account in the weight gain diagram, because they essentially differed from the average readings of other receiving plates. The given mass anomalies are not discussed here, as supplementary observations are needed.

The total mass of the cathode material settled on the receiving plates amounts to 2.65 mg. The weight gain of the plates due to the substance arriving at them from the discharge plasma was averaged over all the plates and was found to be 0.156 mg per conventional plate. Considering the receiving plate size to be 1.2×3.2 cm, we obtain the specific cathode substance flow 0.041 mg/cm$^2$ per receiving plate. The total weight loss by two cathodes for the experimental run consisting of 4006 pulses is equal to 844.8 mg. After deduction of the cathode substance accumulated on the receiving plates and equal to 2.65 mg, we obtain that 842 mg has sputtered on the vacuum chamber walls (anode surface), i. e., the specific flow onto the anode has made 0.0638 mg/cm$^2$. In the order of magnitude, this approaches the value of the specific cathode-substance flow onto the receiving plates.

*a*



*b*

*Fig. 6. Receiving plate surfaces before (a) and after (b) sputtering (×500 magnification)*

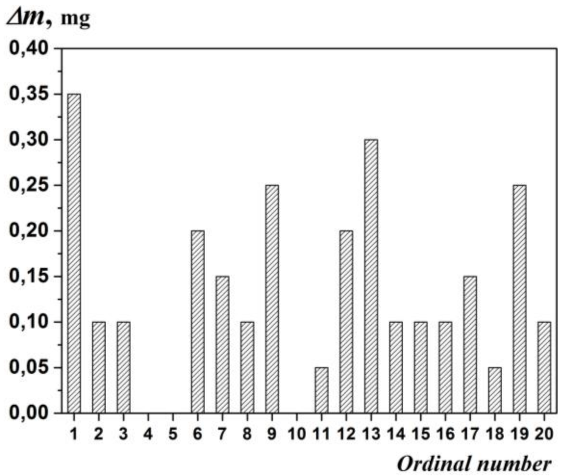



*Fig. 7. Diagram of weight gain by receiving plates*

Before considering the weight distribution of the sputtered cathode metal along the vacuum chamber (anode), mainly on the receiving plates, and aside from that, a possible relationship between the weight distribution of the deposited substance, the value and shape of the magnetic field in the region of cathode material deposition along the longitudinal axis z, we shall estimate the conclusions of the theory [12] of the sputtered metal distribution on the anode surface in terms of the same coordinates. In this case, it has been assumed in [12] that the mean free path length of sputtered atoms $\lambda$ is greater than the dimensions of the discharge gap $\lambda > R, L$, where *R* and *L* are its radius and length, respectively. Regarding that the angular distribution of the substance sputtered off the cathode (cathodes) obeys the cosine law, we obtain the number of particles $\Delta N$ coming in unit time from the cathode $K_1$ to the unit of arbitrary area $\Delta S$ marked on the anode surface and being at a distance $R_1$ from the sputtering area $d\sigma$:

$$\frac{\Delta N}{\Delta S} = \frac{Y}{e} j(r) d\sigma \frac{\cos\varphi_1 \cos\theta_1}{2\pi R_1^2}, \qquad (2)$$

where $Y$ is the cathode sputtering yield; $e$ is the electron charge; $j(r)$ is the ion current density at the given point of the cathode; $\varphi_1$ is the angle of particle emission from the cathode surface, defined as $\cos\varphi_1 = z/R_1$; $\theta_1$ is the angle of particle incidence on the anode surface, defined as $\cos\theta_1 = (r_a - r\cos\alpha)/R_1$, where $\alpha$ is the angle that determines the site of particle emission (sputtering) on the cathode surface.

After integration over the entire cathode surface $K_1$ we obtain:

$$F_1 = \left(\frac{\Delta N}{\Delta S}\right)_1 = \frac{Y}{e}\int_0^{r_k} j(r) r dr \int_0^{\pi} \frac{\cos\varphi_1 \cos\theta_1}{2\pi R_1^2} d\alpha, \qquad (3)$$

where $r_k$ is the cathode radius. A similar expression is deduced for the particles coming to $\Delta S$ from the second cathode $K_2$, and accordingly, $F = F_1 + F_2$. For estimating the distribution of the sputtered substance on the anode surface we take up the geometrical dimensions of the MAKET setup. In the process, taking into account the radial plasma density distribution given by formula (1) and, correspondingly, using the function of ion current distribution on the cathode surface in the form of $j(r) = j_{max}(1-(r/r_k)^2)$ we obtain the sought-for distribution of the sputtered substance on the anode surface coming from one and two cathodes (Fig. 8). As is obvious from Fig. 8 (curve 1), in the one-cathode case, the sputtered substance distribution on the anode surface reaches its maximum at a certain distance from the cathode, and then, it falls off as the distance increases. In the two-cathode case, the distribution shows symmetry about the center of the discharge system (see Fig. 8, curve 2).

For the experimental MAKET facility conditions, the assumption $\lambda > R, L$, made in [12], often fails. At collisions, the sputtered atoms transfer a part of their energy to the gas atoms. At that, according to ref. [19], the sputtered atom transport in the gas-discharge plasma may occur in the diffusion or diffusion-transit-time mode. In the diffusion mode, it is assumed that the most part of sputtered atoms has thermalized, and therefore, the atomic motion is described by the diffusion equation. For the diffusion-transit-time mode, it is characteristic that the number of collisions is insufficient for thermalization and transition to the diffusion mode. In this case, the distance, within which the sputtered atoms go into the diffusion mode (get thermalized), is determined by the relation:

$$h = \lambda_0 \left(\frac{m_1}{m_2}\right)^{0.69} \left[0.39 + 0.23 \ln\left(\frac{E_m}{E_g}\right)\right], \qquad (4)$$

where $m_1$ and $m_2$ are the masses of the sputtered atom and the gas atom, respectively; $E_m$ is the initial energy of the sputtered atom; $E_g$ is the average energy of gas atoms; $\lambda_0$ is the free path length, $\lambda_0 = 1/N_0\sigma$, $N_0$ is the gas atoms concentration, $\sigma$ is the cross section for elastic sputtered atom scattering by the gas atom. The estimation shows that at the energy of sputtered titanium atoms $E_m = 1$ eV and the argon pressure ranging from 0.133 to 4.7 Pa the $h$ value lies between 14.2 and 0.4 cm.

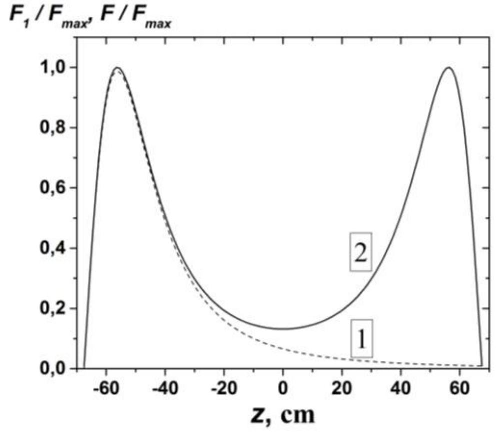



*Fig. 8. Anode surface distribution of the cathode substance coming from one (1) and two (2) cathodes*

In the gas-discharge plasma, the sputtered atom, aside from elastic collisions with gas atoms, participates in inelastic processes resulting in ionization of the sputtered atom. Calculations made in [6, 20] for the experimental conditions have shown that the degree of metal component ionization in the plasma is essentially dependent on the initial plasma density. The remarkable fact is that the highest efficiency of gas-metal plasma generation is observed at the electron density $N_e \geq 10^{13}$ cm$^{-3}$, and the degree of sputtered atom ionization close to 100% is attained. It should be noted that the time of reaching a density of $1 \cdot 10^{13}$ cm$^{-3}$ amounts to ~ 70 μs [4, 6]. With a knowledge of the plasma density and electron temperature it is possible to estimate the free path length of the sputtered atom prior to its ionization using the relation $\lambda_{iz} = v_o/K_{iz}N_e$, where $v_o$ is the initial velocity of the sputtered atom, $K_{iz}$ is the rate constant of neutral atom ionization by electron impact. Taking the plasma density equal to $1 \cdot 10^{13}$ cm$^{-3}$, the electron energy 8 eV, the initial energy of sputtered Ti atoms $E_m = 1\ldots10$ eV, we obtain $\lambda_{iz} = 0.14\ldots0.44$ cm. Consequently, considering the results of refs. [4, 6], it may be expected that a great deal of Ti neutral atoms will be observed in the vicinity of the cathode, while in the remaining volume the Ti atoms will be mainly in the ionized state.

So, the deposit formation on the receiving plates may take place owing to deposition of metal ions in the ionized state; yet, the deposition of the same-type atoms, but in the neutral state, is also not improbable. In view of the balance between the particles coming to the discharge due to the external inlet of working gas and the particles resulting from cathode material sputtering, and also, with account of the measured data on the plasma density, its radial distribution and the rotational speed of heterogeneous plasma layers [4–6, 20], it follows that the arrival of metal ions from the plasma column due to centrifugal effects is the predominant channel for metal particle input and deposit formation on the receiving plates.

We now consider the distributions of the cathode substance deposited on the receiving plates, measured in the experiments of [3] and in the present studies at the MAKET facility. The peculiarity of the given experiments is that the magnetic field in the middle part of the facility is not strictly uniform, undergoing certain deviations from the averaged value. Thus, the deviation from the average magnetic induction value in the positive magnetic field gradient zone makes up +7.1 %, and -6.2 % – in the negative gradient zone.

The maximum quantity of deposit on the receiving plates is determined, among other things, by the plate arrangement in the positive magnetic field gradient zone (Fig. 9). In the zones of negative/zero magnetic field gradients, the reduction in the deposit quantity on the receiving plates is observed. The triangles in Fig. 9 (▲) show the plate weight gain distribution obtained in [3] (curve 1), and the dots (●) represent our present results (curve 2). For comparison, Fig. 9 gives the calculated (see Fig. 8) anode surface distribution of the cathode substance coming from two cathodes (curve 4). The same figure also shows the distribution of magnetic field induction in relative units $B/B_0$, where $B_0$ is the magnetic induction at $z = 0$, $z$ being the magnetic field central point (curve 3).

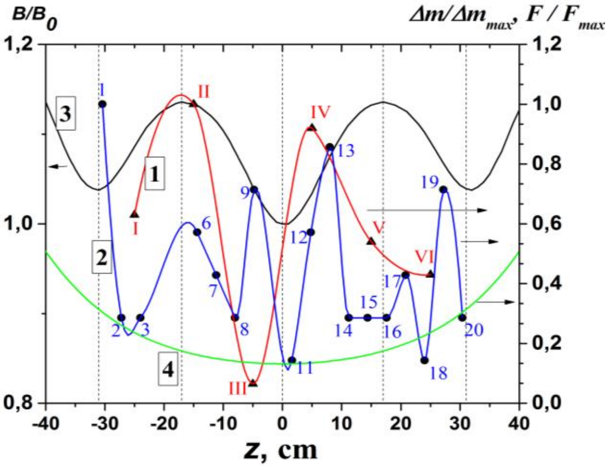



*Fig. 9. Receiving-plate weight gain distribution in relation to magnetic field induction distribution: 1 – distribution measured in [3]; 2 – present work; 3 – magnetic induction distribution in the plates location area; 4 – calculated anode surface distribution of substance coming from two cathodes. The figures on distributions 1 and 2 indicate the receiving plate numbers*

Below, instead of macro parameters of the sputtered cathode substance distributions on the anode or, what is the same, on the receiving plates, we consider the structure of these distributions and some of their special features.

– *Max* and *min* displacements in distributions 1 and 2 (see Fig. 9) can be explained by different geometries of the receiving plates. In case 1, those were discs, 33 mm in diameter, while in case 2 those were rectangles measuring 12×32 mm. Besides, the receiving plate patterns were also different. In the first case, the spacing between the plate centers was about 10 cm, in the second case, it was about 3 cm.

– In case 1, the peak of $\Delta m/\Delta m_{max} = 1$ was observed at a distance of z = -15 cm from the center of the magnetic system (plate No 1), i.e., closer to cathode No 1. In case 2, the maximum was attained at $z = -31$ cm, i. e., 16 cm closer to cathode No 1 (plate No 1).

– Distribution 2 is stronger structured, prompting us to establish a certain relationship (correlation) between the receiving-plate weight gain and the increasing magnetic field regions, e. g., in the interval I–II, curve 1 in Fig. 9 and interval 3–6, curve 2 of the same figure, and also, III–IV and 11–13. A similar correlation is observed in the decreasing magnetic field regions for the intervals II–III and 9–11, as well as for V–VI and 17–18.

– The regions of correlation between the receiving plate weight gain due to cathode sputtering and the magnetic field increase were observed in both the experimental studies of [3] and the present work.

## CONCLUSIONS

1. It has been demonstrated that the maximum quantity of discharge plasma metal deposit on the receiving plates is dependent, among other things, on the plate arrangement in the zone of positive magnetic field gradient. In the zones of negative/zero magnetic field gradients, the reduction in the deposit quantity on the plates located in these zones is observed.

2. Correlation has been established between the receiving-plate weight gain due to deposition of cathode material particles (ionized and, possibly, neutrals) on the plates and the increasing magnetic field regions.

3. It has been shown that the regions of correlation between the receiving plate weight gain due to cathode sputtering and the magnetic field increase were observed in both the experimental studies of [3] and the present work.

4. The titanium cathodes, prepared from a 4 mm thick Ti metal sheet, have exhibited unequal losses in weight. Thus, the loss in weight by cathode No 1, located above the exhaust unit, was found to be 497.6 mg over the whole period of experimenting (4006 pulses). Cathode No 2, remote from the exhaust unit, lost in weight 347.2 mg, this being ~ 30% less than in case of cathode No 1.

5. Based on the obtained experimental data, the highest possible sputtering coefficient has been estimated to be ~ 1.0. Its running values were determined as the functions $Y_{curr} = f(B)$ and $Y_{curr} = f(\gamma)$. The maximum sputtering ratio values, equal to ~ 0.513, are attained in the case of a uniform plasma density profile, i.e., at the power function exponent in eq. (3) $\gamma \geq 8$. The obtained results are in satisfactory agreement with the literature data [2, 18].

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## РАСПРЕДЕЛЕНИЕ МАССЫ РАСПЫЛЯЕМОГО КАТОДНОГО ВЕЩЕСТВА В ОТРАЖАТЕЛЬНОМ РАЗРЯДЕ ВДОЛЬ МАГНИТНОГО ПОЛЯ ПРОБОЧНОЙ КОНФИГУРАЦИИ

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Исследовано распределение распыленного материала катодов под воздействием плазмы импульсного отражательного разряда и осаждаемого на поверхности анода (вакуумной камеры) с помощью набора дискретных приемных пластин. Установлена корреляционная взаимосвязь увеличения прироста массы приемных пластин в результате осаждения на них частиц катодного вещества (Ti) и областей нарастающего магнитного поля. Проведена оценка величины максимально возможного коэффициента распыления $Y_{curr}$. Получены параметрические зависимости коэффициента распыления от показателя степенной функции, определяющего форму радиального профиля плотности плазмы, и от величины индукции магнитного поля.

## РОЗПОДІЛ МАСИ РОЗПОРОШЕНОЇ КАТОДНОЇ РЕЧОВИНИ У ВІДБИВНОМУ РОЗРЯДІ УЗДОВЖ МАГНІТНОГО ПОЛЯ ПРОБКОВОЇ КОНФІГУРАЦІЇ

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Досліджено розподіл розпорошеного матеріалу катодів під впливом плазми імпульсного відбивного розряду і осаджуваного на поверхні анода (вакуумної камери) за допомогою набору дискретних приймальних пластин. Встановлено кореляційний взаємозв'язок збільшення приросту маси приймальних пластин за рахунок осадження на них часток катодної речовини (Ti) і областей наростаючого магнітного поля. Проведена оцінка величини максимально можливого коефіцієнта розпорошення $Y_{curr}$. Одержані параметричні залежності коефіцієнта розпорошення від показника степеневої функції, який визначає форму радіального профілю густини плазми, і від величини індукції магнітного поля.