Low-energy high-current plasma immersion implantation of nitrogen ions in plasma of non-self-sustained arc discharge with thermionic and hollow cathodes

N.N. Koval, A.I. Ryabchikov, D.O. Sivin, I.V. Lopatin, O.V. Krysina, Yu.H. Akhmadeev, D.Yu. Ignatov

PII:	S0257-8972(18)30190-7
DOI:	doi:10.1016/j.surfcoat.2018.02.064
Reference:	SCT 23135
To appear in:	*Surface & Coatings Technology*
Received date:	16 October 2017
Revised date:	14 February 2018
Accepted date:	18 February 2018

Please cite this article as: N.N. Koval, A.I. Ryabchikov, D.O. Sivin, I.V. Lopatin, O.V. Krysina, Yu.H. Akhmadeev, D.Yu. Ignatov , Low-energy high-current plasma immersion implantation of nitrogen ions in plasma of non-self-sustained arc discharge with thermionic and hollow cathodes. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Sct(2017), doi:10.1016/j.surfcoat.2018.02.064

Low-energy high-current plasma immersion implantation of nitrogen ions in plasma of non-self-sustained arc discharge with thermionic and hollow cathodes

N. N. Koval[a], A. I. Ryabchikov[b], D. O. Sivin[b], I. V. Lopatin[a], O. V. Krysina[a], Yu. H. Akhmadeev[a], D. Yu. Ignatov[a,*]

[a] Institute of High Current Electronics, SB RAS, 2/3 Akademichesky Avenue, Tomsk, 634055, Russia

[b] National Research Tomsk Polytechnic University, 30 Lenin Avenue, Tomsk, 634050, Russia

Abstract

This paper presents the results of low-energy high-current implantation of nitrogen ions into AISI 5140 steel. The plasma was generated using a plasma source based on non-self-sustained arc discharge, using thermionic and hollow cathodes. The influence of the temperature of the specimens and irradiation dose on the characteristics of the ion-modified layer was studied. The temperature of the specimens was controlled within the range of (450 – 650) °C by changing the duty factor of the bias pulse and the average ion current density. The microhardness of the steel after 1-hour of low-energy high-current implantation of nitrogen ions increased almost 2-fold (up to 7100 MPa), and a modified layer with a thickness up to 200 μm was formed. The wear resistance increased 7.5-fold. The main factor determining the efficiency of nitrogen dopant penetration was the temperature of the specimen. The parameters of the ion treatment influence the shape of the hardness distribution profile and the efficiency of ion cleaning of the surface.

* Corresponding author. Tel.: +7 3822 49 17 13; fax: +7 3822 49 24 10; e-mail: lopatin@opee.hcei.tsc.ru (D. Ignatov)