

## THE ORDERING AND LONG DISTANCE EFFECTS AT THE DEFECTS' CREATION IN SILICON IRRADIATED WITH HIGH ENERGY HYDROGEN AND GELLIUM IONS

Valentina Varnina, Alla Groza, Petro Litovcheno, Larysa Marchenko, Myroslava Pinkovska, Margaryta Starchyk, Halyna Shmatko  
*Institute for Nuclear Research National Academy of Science of Ukraine, Prospect Nauky 47, Kyiv 03680, UKRAINE; tel.:(00 44) 525 52 38, Fax: (00 44) 525 37 44, e-mail: myrglory@yahoo.com; lpo@kinr.kiev.ua*

Optical and structural properties of silicon single crystals irradiated with energy 6,8 MeV protons ( $F = (1 - 3) \cdot 10^{17} \text{ cm}^{-2}$ ) and 27,2 MeV alpha-particles ( $F = 1 \cdot 10^{17} \text{ cm}^{-2}$ ) have been studied. As the path length of such ions are nearly the same than high defect concentrations are formed by ions with different masses and energies in small silicon thickness. Due to defects' interaction new conditions for defect creation are formed. At high protons' and alpha-particles' fluences ( $10^{17} \text{ cm}^{-2}$ ) defect "walls" are formed perpendicularly to the ion fluence. It testifies about defect ordering due to self-organization – the high dose effects. Defects' "walls" spreading behind braking region of ions in silicon is the long distance effect. The both discovered effects might be useful in order to create modern theory of high energy ion interaction with matter.

## LAMINAR PLASMA JET AS AN INSTRUMENT TO TEST FIREPROOF COATINGS

I.P. Smyaglikov<sup>1)</sup>, V.V. Bogdanova<sup>2)</sup>, O.N. Buraya<sup>2)</sup>  
<sup>1)</sup>*SEC "Plasmoteg", Physical-Technical Institute, National Academy of Sciences of Belarus  
 10 Kuprevich Str., 220141 Minsk, Belarus, ips.imaf@gmail.com*  
<sup>2)</sup>*Research Institute of Physical-chemical Problems of Belarusian State University  
 14 Leningrad Str., 220030 Minsk, Belarus*

The laminar plasma jet generated by an arc plasmatron is described. The structure and temperature fields of the plasma flow near to exit of plasma nozzle are studied by means of optical and spectroscopic methods. Due to high stability, high temperature (up to 10000 K) and weak gas-dynamic pressure the laminar plasma jet can be effectively used to determine fireproof properties of coatings developed especially for the electrotechnical equipment subjected to an arc of short circuit.

### Introduction

Considerable thermal pulses, originating in a short circuit arc, can destroy the walls of electrotechnical equipment followed by development of a fire. In large power networks the short circuit arc can result in heavy system crashes and failure of the expensive equipment (boards, assemblies, distribution boxes). Therefore fire and failure should be restricted within the closed compartment or assembly unit.

Covering of metal surfaces with thermally swelling coatings is one of the most efficient ways of short circuit arc (SCA) protection. Such coatings are usually applied to raise flame-resistance of metal-works when temperature-temporal parameters of a fire have low values (rate of temperature rise during first five minutes is equal to 100-110 K/minute). At the same time application of fireproof paints for SCA protection is problematic due to lack of data about their properties under action of a pulsing high-energy source.

To estimate the fireproof efficiency of materials manifold methods are used, including effect of gas burner flame, heated wire, arc discharge plasma radiation, and short circuit electric arc. It is obvious, that test conditions for fireproof coatings should be as much as possible close to real conditions. However application of short circuit arc for these purposes is expensive and requires complex equipment and high energy consumptions.

The present paper is aimed to application of the laminar plasma jet of an arc plasmatron to determine fireproof properties of coatings developed especially

for the electrotechnical equipment subjected to an arc of short circuit.

### Experiment

The principle of plasmatron operation is generation of electric arc plasma in a stream of inertial gas at atmospheric pressure at low rate in a wide range of currents. The 6 mm tungsten rod cathode shaped to a 60° cone with a plane area 1 mm in diameter was installed at a distance of about 1 gauge from the nozzle exit section. Nitrogen or argon was used as a plasma-forming gas. By means of varying of operating mode parameters (current intensity  $I = 200$ – $500$  A, voltage  $U = 12$ – $40$  V, working gas rate (nitrogen)  $R = 5$ – $20$  l/min., nozzle outlet diameter  $d = 6$  mm) plasma formation stable in space and time have been obtained.

The maximum temperature of nitrogen plasma jet at 300 A at a distance of 0.15 mm from the nozzle exit is about 14000 K [1]. At 3 mm length from the jet axis the temperature goes down to ~ 7500 K. Variation of the discharge current from 300 to 400 A does not result in noticeable growth of plasma temperature.

It was shown that argon laminar plasma jet (current is near 200 A, gas flow rate is 5 to 20 liters per minute) is the most preferable to test fireproof coatings [2]. The plasma formation represents a high-intensity cone-shaped cathode jet (fig. 1). An erosionless operation mode of plasmatron nozzle is observed in this case. The shape of plasma jet in horizontal and vertical position is almost identical, so the convection plays a minor role in its formation.

