

## THE RESEARCH OF THE INFLUENCE OF THE ELECTRIC DISCHARGE ON THE GAS MEDIUM SF<sub>6</sub>

**K.B. GURBANOV**

*Institute of Physics, Azerbaijan National Academy of Sciences,  
Baku. Az - 1143, H. Javid st. 33*

In the article the physicochemical processes, proceeding in the system under the influence of the electric discharge (SF<sub>6</sub> is the dielectric discharge), are investigated. Taking into consideration the content changes in the SF<sub>6</sub> gas medium, the results, confirming the strong influence of the gas medium and electric discharge on the materials, are presented.

Gas, named electric gas (elegas) SF<sub>6</sub>, having high electric strength, has found wide use in the high-voltage technique as an insulator [1,2,3]. In spite of the fact, that the elegas, consisting of two chemically active atoms and being passive in the form of the SF<sub>6</sub> molecule, creates the medium, conserving its simplicity for a long time, and provides the stable work of the high-voltage equipment.

The mechanism of the elegas molecule formation and the connection nature of the new sulphur atoms and six floor atoms have not been studied. Until last years the elegas molecule formation and the idea on the creation of the six covalent connection between sulphur atoms and six floor atoms were submitted as a common hypothesis. The results of the research, conducted in the last years, have called the hypothesis and the mechanism of the SF<sub>6</sub> molecule formation in questions [4]: the idea of the electron charge transformation from sulphur atoms into floor atoms has been put forward. Thus, in the SF<sub>6</sub> molecule the presence of the covalent and ion connection is taken into consideration. According to the two mechanisms, the SF<sub>6</sub> molecule, having the high symmetry, is formed at the expense of the location of sulphur atoms in the center and floor atoms at the octahedral corners. As in the molecule structure the distance between the sulphur and floor atoms is low, the numerical value  $1,57 \cdot 10^{-10}$  has been determined.

The high symmetry and compression, observed in the elegas molecule, provide the resistance to the physicochemical influence.

As the elegas is subject to the electric discharge influence, a number of changes occur in the SF<sub>6</sub> molecule and it may have the negative effect on the elegas medium. From this point of view SF<sub>6</sub>, subjected to the electric influence, has the scientific-technical value in the research of the gas medium [3].

The influence of the torch (flare) electric discharge has been used in experiments. The electrode system, forming the torch electric discharge, enters the close volume and the discharge regime is chosen by the application of the variable voltage on the electrodes. In the case of the value of the applied high voltage is  $U=25$  kV, the value of the electric current is 35 mA.

After the receipt of the vacuum in the system  $10^{-6}$  Pa experiments were conducted by the introduction of the SF<sub>6</sub> gas in the system before the atmospheric pressure. In the close system applying the influence of the electric discharge on the SF<sub>6</sub> gas the changes in the gas medium have been registered by the mass-spectrometer.

The spectrogram, registered by the SF<sub>6</sub> gas in the system, is represented on fig.1.

As it is seen from the fig.1, the spectrogram consists of the SF<sub>6</sub> molecule and the residual gas of the atmosphere air. In spite of the presence of a low number of the water evaporation, oxygen, carbon, nitrogen atoms and molecules, SF<sub>6</sub> shows its neutrality.

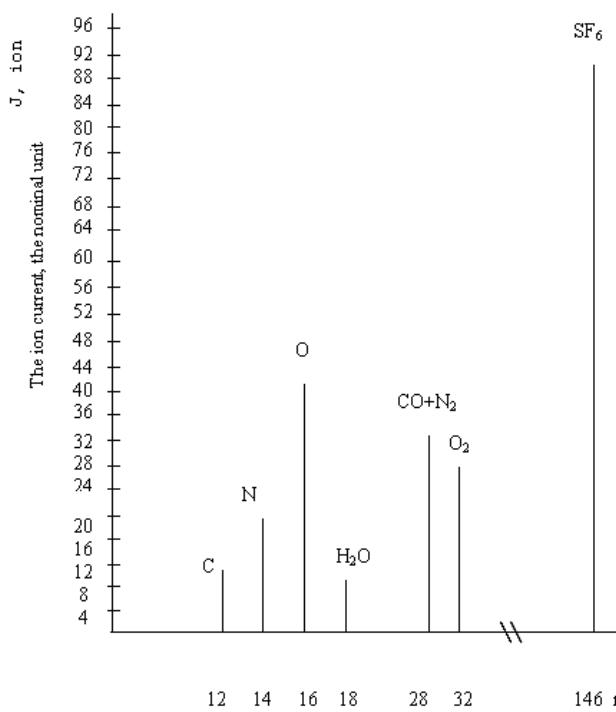


Fig.1. The mass-spectrogram, registered in the gas medium SF<sub>6</sub>

In the above-presented regimes the spectrogram, registered by the influence of the torch electric discharge on the SF<sub>6</sub> gas, is represented on fig.2.

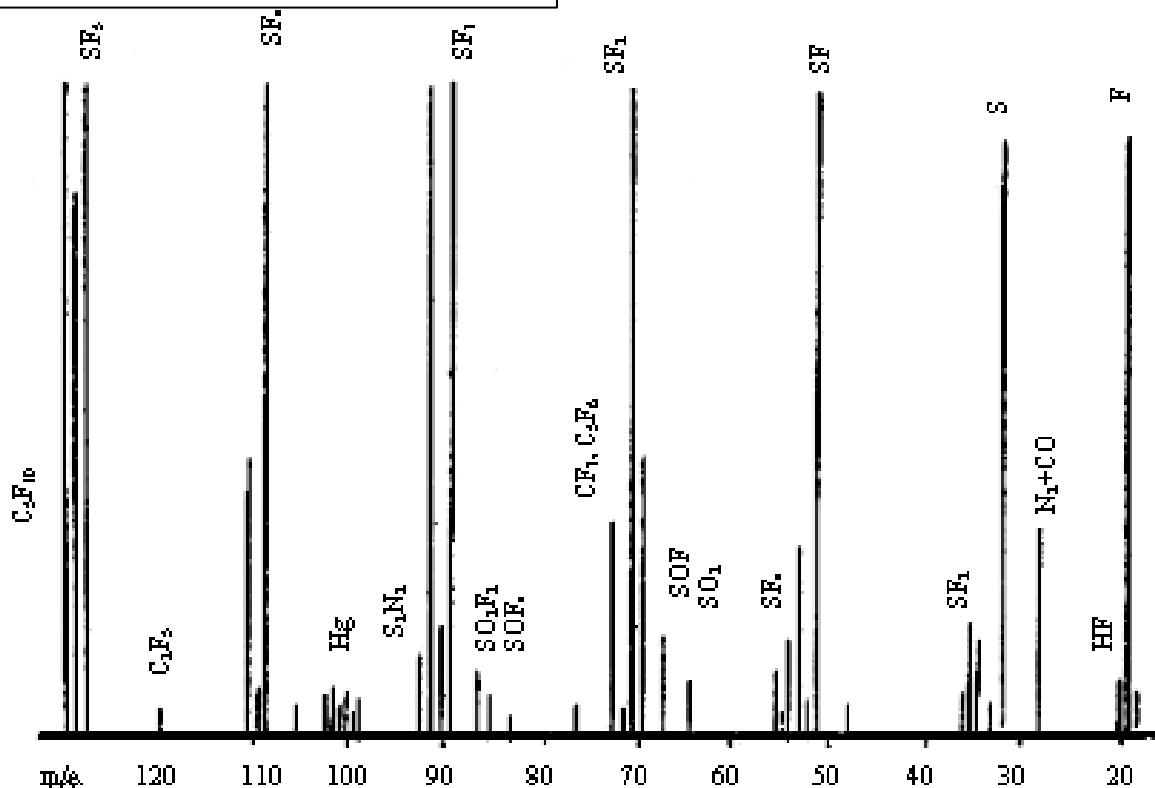
As it is seen from fig.2, the SF<sub>6</sub> gas (SF<sub>6</sub>, SF<sub>5</sub>, SF<sub>4</sub>, SF<sub>3</sub>, SF<sub>2</sub>, SF, S, F) and another ions have been formed under the influence of the electric discharge. It should be noticed, that unlike SF<sub>6</sub> molecule the formed ions, being chemically active, have the strong influence on the gas atoms and molecules and contacting surface. Therefore, as it is seen from the mass-spectrogram, C<sub>2</sub>F<sub>5</sub>, C<sub>2</sub>F<sub>10</sub>, SOF<sub>3</sub>, S<sub>2</sub>N<sub>3</sub>, SO<sub>2</sub>F<sub>2</sub>, SOF<sub>4</sub>, SOF, SO<sub>2</sub>, SO and another molecules have been formed like the above-presented gas SF<sub>6</sub>.

On the spot of the drawn by the needle lines the traces of the depth 100-150 mc are observed on the surface of the ceramic plates and glass, whose surface is fully covered by the dielectric lacquer and placed on the surface of the flat electrode. The results shows, that the medium, formed under the effect of the electric discharge on the SF<sub>6</sub> gas and having

the destructive power on the indicated materials, has a strong influence.

At the formation of the traces on the glass and another materials surface it has been determined by the application of the discharge power and the influence dependence, that both

factors increases the traces depth on the surface and it is possible to cut the glass plate, placed on the flat electrode surface and having the thickness 150 mc, from the desired place during the fixed time and to open holes of the low diameter on its surface.



**Fig.2.** The mass-spectrogram, registered by the influence of the electric discharge on the gas medium SF<sub>6</sub>.

With the purpose of the change of the adhesion, polishing and another properties of some dielectric materials, the indicated properties of the SF<sub>6</sub> gas, subjected to the influence of the electric discharge, are used as a non-mechanical, non-chemical and superior method.

It should be noticed at the same time, that the use of the SF<sub>6</sub> gas as an insulator in the high-voltage equipment production may lead to some difficulties and may have the negative influence on the stable work of the equipment. Taking this into consideration the strict demands should be applied to the simplicity of the SF<sub>6</sub> gas content, used in the high-voltage equipment, to the chosen materials for the production of the technical equipment and to the gas medium content. It is known from the research results, that each of the above-indicated factors has the significant value and the research results, conducted in three directions, have been submitted useful from the point of view of the expansion of the SF<sub>6</sub> gas application sphere. Applying the influence of the electric discharge on the elegas, the new achievements, obtained by the research of the chemical reaction in the gas, have been widely used in the production of the technical devices and materials.

The research results, having the scientific-technical use, have also the significant value in the determination of the

research directions, the modern technological processes, the technical facilities production and the possibility of the scientific base application.

Thus, it is known from the research, that as a result of the gas reaction realization in the gas medium, placed on the discharge interval and influenced by the electric discharge, a row of the momentary, considerable changes are observed in the initial gas medium. In the system versus the initial gas content the various new gas atoms and their compounds, realized by means of the gas reaction, may be formed under the influence of the electric discharge on the material surface and volume, and from the point of view of various aspects it has the significant value in the content research. It is known, that polymer-dielectrics, applied as isolation materials, in the technique and technological processes are subject to the influence of the electric discharge and strong electric region. During the application the changes, observed in the chemical and electro-physical properties of dielectrics, may disable these materials, applied as insulator. In these processes side by side with the another factors the medium, surrounded by the dielectrics, and changes, occurring in this medium under the effect of the electric discharge, have the decisive influence.

- [1] N.N. Tihodeyev. The transmission of the electric energy-Leningrad-Energoatomizd, 1984.  
 [2] Ch.M. Juvarl, Y.V. Gotin, R.N. Mehdizade. The corona discharge in the electronegative gas-“ELM”, 1988.  
 [3] V.M. Smirnov. The negative ions-M: “Atomizdat”, 1978  
 [4] I.M. Bortnik.-Elegas-M: “Nauka”, 1982.

**K.B. Qurbanov**

**QAZBOŞALMASININ SF<sub>6</sub> QAZ MÜHİTİNƏ TESİRİNİN TƏDQİQİ**

Məqalədə elektrik qazboşalmalarının təsiri nəticəsində «SF<sub>6</sub> – qazboşalması təsiri» sistemində müşahidə olunan fiziki proseslər tədqiq edilmişdir. SF<sub>6</sub> qaz mühitində tərkib dəyişmələri qeydə alınaraq, SF<sub>6</sub> qaz mühitinin, qazboşalmalarının təsiri şəraitində, materiallara güclü təsirə vasitəsi olmasına təsdiqləyən nəticələr təqdim olunur.

**К.Б. Гурбанов**

**ИССЛЕДОВАНИЕ ВОЗДЕЙСТВИЯ ЭЛЕКТРИЧЕСКОГО РАЗРЯДА  
НА ГАЗОВУЮ СРЕДУ SF<sub>6</sub>**

В статье представлены результаты исследований физико-химических процессов, происходящих в системе «SF<sub>6</sub> – воздействие электрического разряда». Выявлены изменения газовой среды SF<sub>6</sub> в условиях воздействия факельного электрического разряда. Установлены факты, подтверждающие химическую активность ионов элегаза, образованных вследствие воздействия электрического разряда.

*Received: 26.02.03*