

NEW POSSIBILITIES OF ARCHED ATOMIC-EMISSION SPECTROMETRY FOR A STUDY OF THE GEOOBJECTS COMPOSITION

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Key words: *Arc spectrometry, heavy excitable elements, photoelectronic cassette*

Despite of development of new technologies of substance research (such as atomic absorption spectrometry or atomic emission spectrometry with inductively-coupled plasma), atomic emission spectrometry in a variant of sample evaporation from electrode crater still takes the important place in the analysis of geological objects. However sources of spectra excitation (constant or alternating current arc, spark), used for analysis of powdered samples, do not allow to receive atomic spectra of heavy excitable elements which include practically all halogens, sulfur and nitrogen.

Atomic- emission spectra of nonmetals are relatively simple, which is caused by the structure of the electron levels of atoms, but the connection of optical electrons with nucleus is very great (see table.); therefore for excitation even low levels of nonmetals the large amount of energy is required and the spectra of nonmetals cannot be obtained by means of the usual spectral technique. It is possible to explain as follows [1, 2]:

1. Excitation and ionization potentials of nonmetals are considerably higher than potentials of metals and radicals.
2. The most sensitive (resonance) lines of nonmetals are located in the vacuum region of spectrum and for excitation of these lines vacuum spectrograph is required.
3. Sensitive lines in the visible range of spectrum, which are intercombinatory transitions, they have high excitation potential and for their obtaining powerful radiation sources are required.

Table

Some parameters of spectral determination of elements

Element	Analytical line, nm	Excitation potential, eV	Ionization potential, eV
B	249.8	4.96	8.30
N	746.8	11.99	14.53
P	253.5	7.22	10.48
S	675.7	9.70	10.36
	858.5	9.29	
F	685.6	14.50	17.42
Cl	837.6	10.40	13.01
	725.7	10.62	
Br	827.2	9.36	11.84
	663.1	9.73	
I	804.4	8.31	10.45

In the work is proposed the updated scheme of conducting the analysis of any powdered samples, including of rocks, minerals, experimental samples for determining of fluorine, chlorine, bromine, iodine, phosphorus, sulfur from the sample with a mass of 10-20 mg without the preliminary chemical processing.

On basis of previously developed by us high-temperature arc plasmatron [3, 4] an analytical complex is created, which makes possible to solve the problem of heavy excitable volatile elements determination. Plasmatron with the consumable carbon electrodes and helium as plasma-forming gas allows to obtain stable plasma jet with high temperature (up to 15000°) with a comparatively small arc current (40-50A) and the low gas flow (10 l/min). The application of helium, gas with the high ionization potential and high thermal conductivity creates favorable conditions for the excitation of atomic lines of elements with the excitation potentials up to 15 eV (fig. 1).

An important component of the proposed spectral complex is contemporary registration of spectra with the use of the photoelectronic cassette on linear CCD by firm "MIRS", placed in the spectrograph PGS-2 with the dispersion of 0.74 nm/mm in a wide range of wavelengths. Working spectra and calculations of the analysis results are carried out with the use of computer software.

The most sensitive analytical lines of halogens sulfur and nitrogen, excited by plasma arc in helium, are located in the long-wave region of the spectrum. This complicates conducting analysis, be-

cause spectral line intensity in this region of spectrum is small in comparison with the brightness of continuum, and measurements in the line spectrum are conducted with small accuracy and sensitivity. However, the use of a photo electronic cassette significantly decreased this complication, making possible to conduct the elements determinations in a wide area of concentrations n ($10^0 - 10^{-4}$) % . .

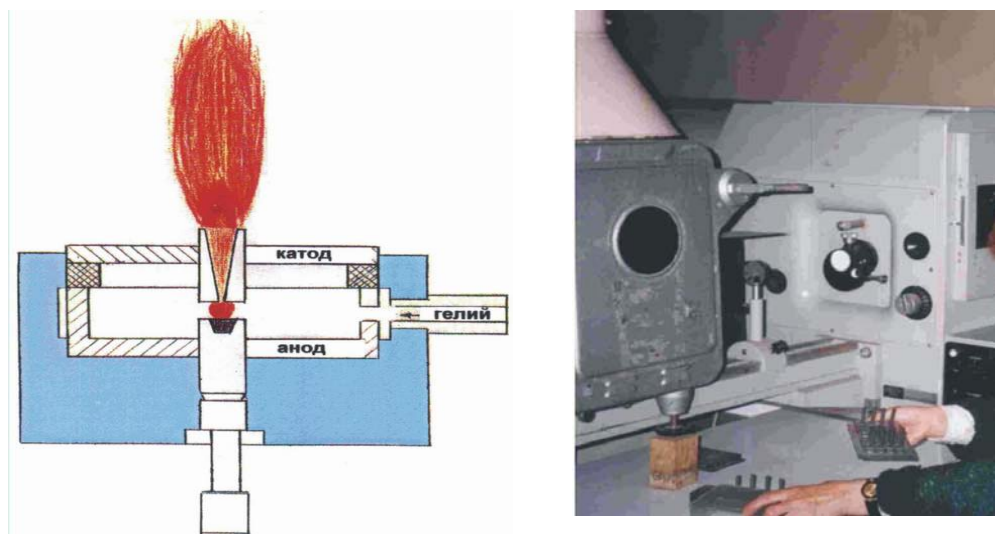


Fig.1. Plasmatron: general view (right) and torch (left)

Advantages and the merit of the proposed method:

- 1 - Straight analysis of any powder samples without the preliminary chemical treatment;
- 2 - Simultaneous determination of the heavy excitable volatile nonmetals, and also other elements;
- 3 - Possibility of analysis of small samples (from 5 to 20 mg);
- 4 - Absence of matrix influences with a change in the total composition of samples, which allows to work with the united standard samples;
- 5 - Rapidity and the cheapness of method.

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Electronic Scientific Information Journal "Vestnik Otdelenia nauk o Zemle RAN" № 1(27) 2009
ISSN 1819 – 6586

Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2009
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2009/informbul-1_2009/elaborate-7e.pdf

Published on July, 1, 2009

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