

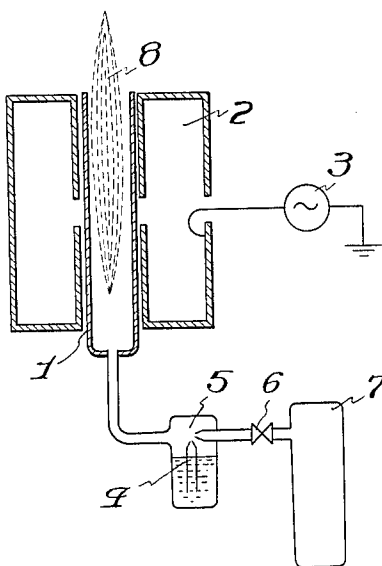
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PLASMA LIGHT SOURCE FOR SPECTROSCOPIC ANALYSIS

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PLASMA LIGHT SOURCE FOR SPECTROSCOPIC ANALYSIS

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1 Claim. (Cl. 88—14)

This invention relates to techniques in and means for spectroscopic analysis. More particularly, the invention relates to a new and improved construction of spectroscopic apparatus suitable for application as a light source for spectroscopic analysis created by a high-temperature plasma of a temperature as high as several thousands to ten thousand degrees centigrade which is generated by electrical discharge.

In conventional spectroscopic analysis methods, for example, flame spectrometric analysis wherein solution samples are used, the excitation source for the solution samples has been obtained almost invariably in the form of a chemical flame. In such a chemical flame, however, the temperature is low, and it has been difficult to accomplish excitation of heavy metals. Recently, however, high-temperature plasmas of temperatures reaching several thousands of degrees centigrade through such means as plasma jets are being utilized, and the above-mentioned difficulty is being overcome. In addition, numerous advantages which were not realized hitherto are being realized. However, in order to generate a plasma jet, two opposite electrodes, that is, positive and negative electrodes, are required. Unless these electrodes are constantly protected by inert gases during discharge, the electrode foot points erode progressively until the discharge becomes unstable. Therefore, when introducing various solution samples into a high-temperature plasma, it is necessary to determine in a suitable manner such factors as the construction of the electrodes and the arrangement of the sample introducing means so as to prevent these samples from coming into contact with the electrode foot points of the discharge. This necessity presents considerable problems of design.

The present invention in its broader aspects contemplates avoiding the above-mentioned difficulty accompanying the utilization of two-electrode discharge plasma.

It is an object of the invention to provide a new spectroscopic apparatus where in a high-frequency electrodeless discharge plasma is utilized as a means for creating a spectroscopic light source.

The nature, principle, and details of the invention will be more clearly apparent by reference to the following detailed description of a preferred embodiment of the invention, when taken in conjunction with the accompanying drawing which is a schematic diagram, in vertical section and partly including an electrical connection diagram, indicating the embodiment.

Referring to the drawing, the plasma flame generator therein shown comprises a centrally disposed discharge chamber 1 made of an electrically insulating material, a cavity resonator 2 encompassing and disposed substantially concentrically relative to the discharge chamber 1, a high-frequency power source 3 connected to a part of the cavity resonator 2, a sample container 4, a sample sprayer, for example a sample atomizer 5, having a delivery side communicating with the bottom of the discharge chamber 1, a pressurized gas reservoir 7, and a valve 6 for regulating the flow rate of gas supplied to the atomizer 5.

The plasma flame generator of the above-described constructional arrangement has the following operation.

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First, high-frequency electrical power generated by means of the high-frequency power source 3 is supplied to the cavity resonator 2 to cause the creation of a high-frequency electric field in the interior of the discharge chamber 1 disposed in the hollow space of the said cavity resonator 2. A sample to be analyzed is atomized by and mixed with a gas which is relatively conducive to the creation of electrical discharge, such as, for example, argon, and the mixture so produced is sent into the aforesaid discharge chamber 1 through one end thereof. This mixture so sent into the discharge chamber 1 is excited by the afore-mentioned high-frequency electric field and forms a discharge plasma 8. The electron temperature of this discharge plasma rises to a value of from several thousands to ten thousand degrees centigrade, and it is easily possible to cause excitation of the sample to be analyzed by means of this high-temperature plasma.

By the use of the spectroscopic analysis apparatus of the above-described compositional arrangement, since a high-temperature plasma is used for the excitation of the sample to be analyzed, the excitation of heavy metals is substantially facilitated. Accordingly, the range of materials which can be analyzed by the apparatus of this invention is much wider than that of conventional apparatuses of this type. Furthermore, in addition to the increase in capacity for analysis, since there is no erosion whatsoever of the electrodes by the solution sample as in the case of a direct-current arc plasma jet, the discharge in the apparatus of the present invention is maintained in an extremely stable state. Therefore, by the use of the apparatus according to this invention, the light-emission states of samples being analyzed are stable, and analysis with high precision is possible by means of the spectroscopic analysis apparatus in which the above-described high-frequency electrodeless discharge plasma is used for causing the sample to emit light.

Although the present invention has been described with respect to a particular embodiment thereof, it is not to be so limited as changes and modifications can be made therein which are within the full intended scope of the invention, as defined by the appended claim.

What is claimed is:

A spectroscopic analysis apparatus having as its light source a plasma flame generator of high-frequency, electrodeless discharge type which comprises a centrally disposed discharge chamber formed from an electrically insulating material, a cavity resonator encompassing and disposed substantially concentrically relative to the said discharge chamber for supporting a high-frequency electric field in the interior of the said discharge chamber, a high-frequency power source for supplying high-frequency power to the said cavity resonator, a sample container for storing a sample to be analyzed, a sample sprayer having a delivery side communicating with the said discharge chamber for spraying the sample in said sample container into said discharge chamber, a reservoir coupled to said sample sprayer for storing a gas to be used for spraying the said sample by the said sample sprayer, whereby said sample is mixed with said gas and the mixture transported into said chamber there to be excited by said electric field, thus forming a discharge plasma.

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