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ІНСТИТУТ АВТОМАТИКИ, ЕЛЕКТРОНІКИ ТА КОМП'ЮТЕРНИХ СИСТЕМ УПРАВЛІННЯ

MEASUREMENT, CONTROL AND DIAGNOSIS IN TECHNICAL SYSTEMS

ДРУГА МІЖНАРОДНА НАУКОВА КОНФЕРЕНЦІЯ

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У збірнику опубліковано матеріали конференції, присвяченої проблемам теоретичних основ вимірювань, контролю та технічної діагностики, інформаційно-вимірювальних технологій та метрології.

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PHYSICAL NATURE METROLOGICAL SELECT OF RANGE OF INFRARED WAVES TO OPTICAL ABSORPTION METHODS OF CONTROL FLUE GAS BOILERS

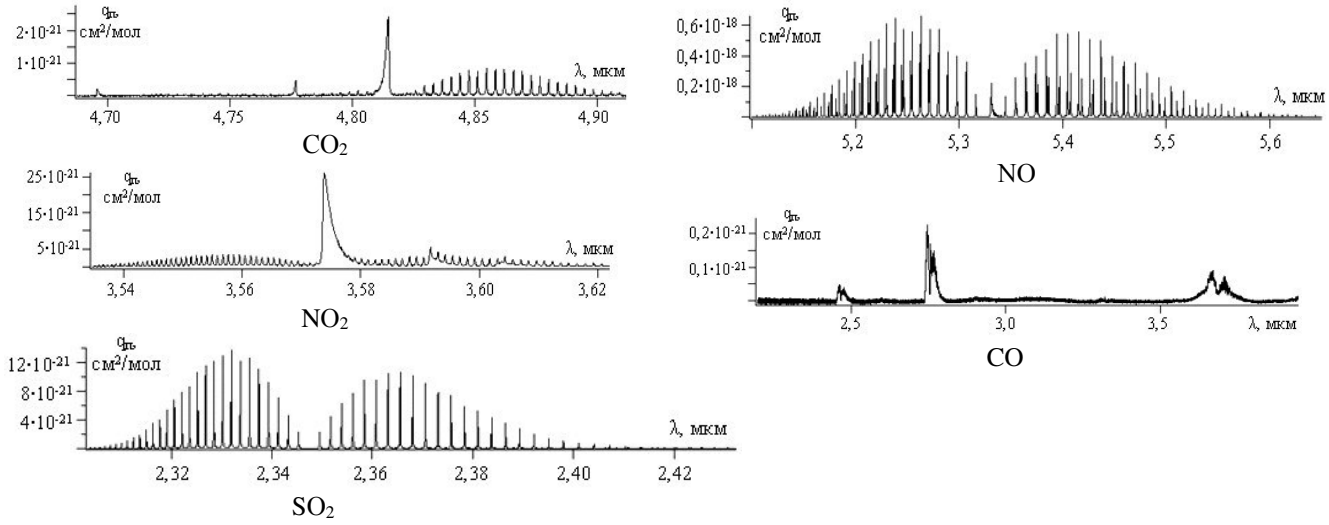
Keywords: infrared wave absorption line, range, wavelength range.

Introduction. In [1] proposed the construction of the control system of flue gas boilers. Its operation is based on the method of infrared absorption spectroscopy, it raises the problem of the study of the absorption spectra of gases during combustion, and the spectra of atmospheric gases that are actively absorb radiation in the infrared region of the spectrum.

Problem. Select length of the absorption bands of gas boilers that meet the following requirements:

1. In compliance with intense infrared absorption
2. It is necessary to take into account the absorption lines of other gases (effect cover)

The main part. In [2] presented the main flue gases and their concentration. It is for these gases present spectral characteristics according to each task (Figure 1).



In the slides that presented above clearly shows a strong absorption band emissions. At wavelengths between different gases are disjoint (completed task two).

Infrared absorption spectrum – unique in its own way physical property. No two compounds, except for optical isomers with different structures but similar infrared spectra. In some cases, such as polymers with close molecular weight differences can be almost invisible, but they are always there. Most of the infrared spectrum is a "fingerprint" of the molecule, which can easily be distinguished from the spectra of other molecules.

The most extensively for chemical analysis and spectroscopic gas detection using mid-infrared range (2.5 ... 20 mm), where the strong absorption bands of many gases. In the near infrared range (0.75 ... 2.5 mm) absorption bands are weaker and this range is usually less suitable for the detection of trace gases.

In the visible region (0.38 ... 0.76 mm) only a few gases have absorption bands. And in the ultraviolet region (0.2 ... 0.38 mm) and a diatomic.

Each substance has its own set of energy levels, unlike a number of other substances levels and the difference of their energies. Therefore, the spectra of different substances differ. The nature of change in the internal energy of the molecules in the absorption of photon radiation is rotational, vibrational and electronic spectra.

Infrared radiation middle range gives vibrational spectra, which reflect the change in the vibrational energy of the molecules of the substance.

Fluctuations in polyatomic molecules are quite complex. From the number of active vibrations, the number of oscillations, accompanied by a change in the dipole moment of the molecule depends on the number of absorption bands in the infrared spectrum.

Consider the absorption maxima for the gas concentration is planned to determine (Figure 2).

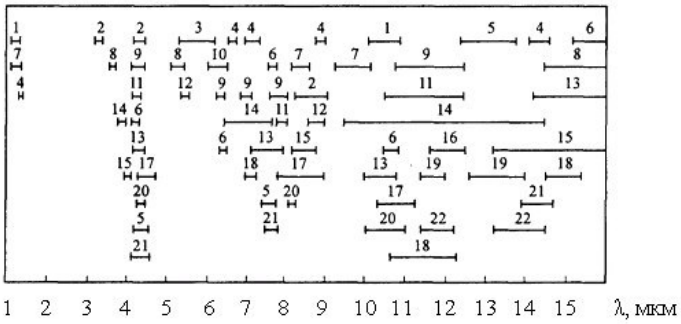


Figure 2. Absorption bands of certain gases in the spectral range 0.25 ... 15 microns
1 – O_3; 2 – CH_4; 3 – CO; 4 – NO_2; 5 – C_2H_6; 6 – C_6H_6; 7 – SO_2; 8 – CO_2; 9 – C_3H_6;
10 – NO; 11 – C_2H_4; 12 – N_2O; 13 – C_7H_8; 14 – NH_3; 15 – C_2H_2; 16 – C_4H_6;
17 – CH_3OH; 18 – C_2H_3Cl; 19 – C_2HCl_3; 20 – C_2H_5OH; 21 – C_3H_8; 22 – C_2Cl_4

Due to anharmonicity fluctuations than fixed frequency con-sterihayutsya and weak bands. It should be noted that at wavelengths close to the above, the water molecules will actively interfere with the definition of other gases, blocking of their spectra. In addition, there is also a less intense absorption bands of water molecules, which is also part can affect the outcome. Because of the spatial division of a molecule of water vapor can make free translational and rotational motion . Recently, interacting with the vibrational levels of molecules, leading to their cleavage. As a result, the spectrum of water vapor rather large (several tens of inverse centimeters) vibrational bands characteristic of the substances in the condensed state, consists of a large series of lines on the half-width of 0.05-0.5 cm- 1. Therefore, when choosing characteristic wavelengths for measurement should try to get into the so-called "window of transparency", free from the strong absorption of the main atmospheric sinks (molecules of water vapor, carbon dioxide, etc.). It should also be mentioned that, generally, the spectra of organic compounds (which will also be determined) does not contain too narrow absorption bands, since both the change of vibrational energy of molecules can be changes and rotational energy.

If the transition energy of the molecule consists only of a purely vibrational transition can be expected in the spectrum of a single narrow peak. Indeed, substances that are in the condensed state, give IR bands of this type. In the gas phase to the vibrational transition of added rotational transitions, and these state changes compatible fill a large area width.

Feature also works in the infrared region of the spectrum is the low intensity radiation sources with continuous spectrum that operate at relatively low temperature radiation. Raising the temperature according to Wien's displacement law would result in a shift of the maximum radiation in the shortwave region of the spectrum. Also in this case would have violated the law of Bouguer-Lambert-Beer is valid within the linear optics, within such radiation intensities at which it does not change the properties of the medium.

Conclusion. Recommendations for further research will use high-precision radiation sources with as narrow a width range of radiation.

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