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The Use Of Photometry In The Process Of Capturing Images.

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Annotation

Photometry is widely used as a reliable and versatile detection method in the general analytical chemical literature and in some flow injection assays (FIA). Photometry is used to describe the evaluation of properties of light sources such as emission characteristics, color temperature, and color rendering index in a color image. For analytical chemists, photometry is mainly concerned with absorbance measurements for the purpose of quantifying analytes using special instruments called "photometers". The following article is devoted to the use of photometry in the process of capturing images.

Key words: photometry, photometers, spectrophotometry, wavelength, colorimetry, light effect, photographic emulsion.

Spectrophotometry is a specific form of photometry in which light is measured as a function of wavelength over a specific range. "Colorimetry" refers to the measurement of light transmission. Instrumental aspects of flow spectrophotometry are discussed, such as components, flow cell design for absorbance measurements, photometric detectors based on LEDs, and spectrophotometric detectors based on optical fibers.

Spectrophotometric instruments fall into three categories: (1) fixed wavelength detectors, using filters to isolate a single band of radiation, (2) variable wavelength detectors, using a continuous light source and a monochromator to select the appropriate wavelengths, and (3) detectors , which can quickly perform fast and complete scans over a wide range of wavelengths. This chapter also discusses background absorption correction and refractive index effects.

Since the middle of the last century, the photographic method of recording radiation has been used in astronomy. He currently occupies a leading position in the optical methods of astronomy.

Long exposures on highly sensitive plates make it possible to obtain photographs of very faint objects, including those that are practically inaccessible to visual observation. Unlike the eye, photographic emulsion is capable of long-term accumulation of light effect. A very important property of photography is panorama: a complex image is simultaneously recorded, which can consist of a very large number of elements. Finally, it is essential that the information obtained by the photographic method does not depend on the properties of the observer's eye, as is the case with visual observations. A photographic image, taken once, is stored indefinitely, and it can be studied in the laboratory.

A photographic emulsion consists of grains of silver halide (AgBr, AgCl, etc.; different types of emulsion use different salts) suspended in gelatin. Under the action of light, complex photochemical processes occur in the grains of the emulsion, as a result of which metallic silver is released. The more light absorbed by a given area of the emulsion, the more silver is released.

Halide silver absorbs light in the region l < 5 0 0 0 E. The spectral region 3000-5000E is

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sometimes called photographic (similar to visual, 3900-7600E). To make the emulsion sensitive to yellow and red rays, organic dyes are introduced into it - sensitizers that expand the region of spectral sensitivity. Panchromatic emulsions are sensitized emulsions sensitive up to 6500-7000E (depending on the variety). The spectral sensitivity curves of various emulsions are shown in the figure. they are widely used in astronomical and conventional photography. Infrachromatic emulsions are much less common, sensitive to infrared rays up to 9000E, sometimes up to 13000E.

The stars in the photographs come out as circles. The brighter the star, the larger the circle at a given exposure. The difference in the diameters of photographic images of stars is purely a photographic effect and has nothing to do with their true angular diameters. As a rule, only the negatives themselves are subjected to scientific processing, since the information contained in them is distorted during reprinting. Astronomy uses both glass plates and films. Plates are preferable in those cases when the relative position of objects is studied from the negatives. Comparing photographs of the same part of the sky taken on different days, months and years, one can judge the changes that have occurred in this area. Thus, the displacement of small planets and comets (when they are far from the Sun and the tail is not yet visible) among the stars is easily detected by comparing the negatives obtained with an interval of several days. The proper motions of stars, as well as individual clumps of interstellar matter in gaseous nebulae, are studied from photographs taken over long time intervals, sometimes reaching many decades. Changes in the brightness of variable stars, outbreaks of new or supernovae are also easily detected by comparing negatives obtained at different points in time.

Photoelectric microphotometers are used to measure the blackening of the negative. In these devices, the intensity of the light beam passing through the negative is measured by a photocell.

The main drawback of the photographic plate of the radiation receiver is the non-linear dependence of blackening on illumination. In addition, blackening depends on the processing conditions. As a result, the accuracy of photometric measurements made by the photographic method usually does not exceed 5-7%.

Photometric measurements

A prominent place in optical measurements is occupied by questions related to the determination of the energy characteristics of light radiation. These include, in particular, measurements of light fluxes in order to determine the transmission of various media, which is important for the certification of optical materials, determining the illumination of objects when photographing, finding the distribution of illumination or blackening when solving problems of optical information processing.

In most cases, photometric measurements determine the relative fluxes of radiation energy and, relatively rarely, their absolute values. Fundamentally, the absolute values of radiation energy fluxes are not difficult to measure, since they obey the same conservation laws as in other physical phenomena. To do this, it is sufficient, for example, to apply the radiation under study through a small hole in a calorimeter isolated from the external environment so that it is completely absorbed by the blackened walls of the calorimeter. Then measure the change in temperature of the calorimeter for a certain time of exposure to radiation.

The amount of heat per unit time is the magnitude of the radiation energy flux, i.e. its power. However, there are serious problems with determining the heat capacity of the calorimeter, which must be known with sufficiently high accuracy, since the measured radiation fluxes are small. In addition, with a long-term action of flows on the calorimeter, thermal leaks are inevitable, which are rather difficult to take into account. In the case of relative measurements of radiation energy fluxes, there is no need to know the heat capacity of the calorimeter, it is enough to ensure its invariance at least in two successive readings.

In practice, when measuring the relative fluxes of radiation energy, more sensitive radiation detectors are used than calorimeters, for example, thermoelements, thermopillars, bolometers, etc. Even more sensitive receivers of radiation energy fluxes are photoelectric receivers: photocells, photomultipliers, photoresistors, etc. However, unlike thermal radiation energy receivers, they have spectral selectivity and respond not to the entire radiation energy flux, but only to some of its spectral part. For relative measurements, this is generally not significant, since in most cases, the magnitude of the luminous flux is determined in a limited spectral range. Sometimes these measurements are associated with strictly monochromatic radiation fluxes. The problems of monochrome photometry are the simplest in comparison with the problems of heterochromic photometry associated with the comparison of energy fluxes of radiation of different wavelengths.

Methods of photometric measurements, and hence the design of devices, depend on the radiation receiver used. For example, the eye reacts to brightness, photographic emulsion - to irradiance, photoelectric receivers - to radiation fluxes. In accordance with radiation detectors, photometry methods are usually divided into three groups: visual, photographic, and photoelectric.

In visual photometric measurements, the observer's eye is used as a radiation receiver, and since there is no objective criterion for measuring brightness in this case, the ability of the eye to compare the brightness of two light fields that are visible simultaneously is used, and one of the light fields must be a reference and its brightness should be known.

Photographic methods use the photochemical effect of radiation on a photosensitive layer. These measurements consist in comparing the blackening of photographic materials. However, such a comparison can be made either visually or by photoelectric methods, and essentially at this stage, photographic methods are reduced to either visual or photoelectric methods.

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