Dosimetric characteristics.

In X-ray computed tomography, two dosimetric characteristics are of the greatest practical importance:

– Computed Tomography Dose Index (CTDI) and Dose Length Product (DLP).

The following characteristics are monitored on positron emission tomographs:

– image uniformity;
– spatial resolution;
– signal-to-noise ratio;
– stability of the detector system;
– cross calibration factor.

The following characteristics of positron emission tomographs combined with X-ray computed tomographs are monitored:

– cross-calibration coefficient and a comprehensive verification of a system in the clinical trial mode;
– a shift of the observation zone.

As a result of this work, we have established a list of characteristics that have to be periodically monitored. This list is sufficient for optimal control and ensuring the correct operation of the device.

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REQUIREMENTS FOR THE POSITRON-EMISSION TOMOGRAPHY COMBINED WITH THE X-RAY COMPUTER TOMOGRAPH

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The requirements for positron emission tomography equipment combined with an X-ray computer tomograph to ensure accurate apparatus operation are presented. The substantiation of the need for creating clinically acceptable quality assurance programs in a particular PET department is given, which allows the control of the basic scanner characteristics.

Keywords: positron emission tomography, computed tomography, PET department, PET/CT scanners, quality of PET / CT images, oncology, quality control, quality assurance program, IEC standards, NEMA, IAEA.

Positron emission tomography (PET) is used in neurology, cardiology and oncology. The combination of PET and computed tomography (CT) has significantly increased the diagnostic value of medical images, because CT images carry anatomical information, and PET carries metabolic information. The applying of PET onto CT images allows localization of the radiopharmaceutical accumulation centers with a high degree of accuracy.

To ensure high diagnostic quality of PET / CT images, constant monitoring of the scanner characteristics is required to timely detect their deviations from the values declared by the manufacturer and to take appropriate measures.

Modern medical diagnostics imposes strict requirements on the information content of images, so the issue of quality assurance is quite urgent. Often, manufacturers recommend a rather reduced set of measurements that do not provide a quality assurance in accordance with international and national standards. In addition, not all measurements included in these standards can be performed on a particular scanner due to the lack of necessary phantoms and the features of its software. Thus, there is a need to develop a quality assurance program adapted to the conditions of a particular PET department.

There are various standards for the acceptance and routine testing of PET/CT scanners. The standards governing acceptance tests can also be used for routine measurements, if necessary.

Of particular note is the lack of official standards governing the comprehensive testing of combined PET / CT scanners. In this regard, there are only recommendations from the IAEA and manufacturers of such scanners.

Thus, a program should be drawn up to guarantee the operation quality of the apparatus based on an analysis of international IEC standards, state IEC GOST R, NEMA standards, IAEA and manufacturer recommendations, and taking into account the presence of necessary phantoms.

As a result of this work, the necessity of creating a quality assurance program in the context of a particular PET department was substantiated, the purpose of which is to control the key characteristics of the scanner to ensure its correct operation.

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PHOTODEGRADATION OF CAFFEINE OVER PLASMA TREATED ZNO-BASED CATALYSTS DOPED WITH AG NANOPARTICLES

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The photocatalytic degradation of caffeine was studied over ZnO-based catalysts. The activity of catalysts in reaction of photodegradation of caffeine was compared with that in reaction of degradation of methyl orange. It was shown that plasma treated ZnO-based photocatalysts doped with Ag nanoparticles can be used to treat the pharmaceutical wastewater.

Keywords: photocatalyst, photodegradation, ZnO, photometry, methyl orange, nanoparticles, Ag, optical density, pharmaceutical waste.

Within the last few years, occurrence of pharmaceutical wastes and their metabolites in environmental have attracted scientific interest. The pharmaceuticals consists of biologically active compounds which are hard to be destructed by conventional technology [1, 2]. Heterogeneous photocatalysis is considered to be one of the promising method to remove the pharmaceuticals from the water [1, 2].

The aim of this study was to investigate degradation kinetics of caffeine by plasma treated ZnO-based catalysts. Enhancement of photocatalysis by doping of catalyst with Ag nanoparticles (NPs) was also evaluated. The experimental details can be found elsewhere [3]. The activity of catalysts in reaction of photodegradation of caffeine was compared with that in reaction of degradation of methyl orange (MO). The photocatalytic reaction was monitored spectrophotometrically by observing absorbance of caffeine and methyl orange at the peak absorbance wavelength (λ_{max} = 272 nm and λ_{max} = 465 nm, respectivelly). The rate of decomposition (C_r) was calculated as:

$$C_r = \frac{C}{C_0} \cdot 100\% = \frac{A_t}{A_0} \cdot 100\%,$$

where C_0 is initial concentration of dye (caffeine) solution, C is concentration of dye (caffeine) solution at any time t after photoirradiation, A_0 and A_t are the initial absorption and absorption at photoirradiation time t at the λ_{max} = 272 nm or λ_{max} = 465 nm. As it is seen from Figure 1 the ZnO-based catalyst doped with Ag-NPS is as effective in the caffeine photodegradation reaction (ZnO DBD Ag caffeine) as in the methyl orange dye photodegradation reaction (ZnO DBD Ag MO). The photodegradation reactions of caffeine and methyl orange at initial concentrations of 300 mg/L and 50 mg/L in the presence of a silver-doped ZnO-based catalyst have the same reaction rate – $k = 3.6\ 10^{-3}\ s^{-1}$. Figure 1 also shows data on the photodegradation kinetics of methyl orange in the presence of untreated ZnO-based catalyst. The reaction rate constant was $k = 1{,}4\ 10^{-3}\ s^{-1}$.

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