PORTABLE GAMMA/X-RAY SPECTROMETER

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This paper reviews the research, design and prototyping of a gamma ray detector capable of analysing gamma ray emissions in the range of 50 keV to a few MeV. The objective of the project is to produce accessible portable gamma spectrometer enabling gamma ray energy resolution in a broad range to maximize applications of the device. The primary objective of the project is to measure gamma ray spectrum from radioactive sources over a wide energy range using a silicon detector accurately.

Gamma-ray spectroscopy is an important method of analysis used every day in the applied fields, such as the nuclear industry, geochemical investigation and astrophysics for the quantitative study of the energy spectra of gamma-ray sources. Applying this technology in nuclear engineering, astrophysics, geochemistry, nuclear materials safety and in quality control of raw materials manufacturing gives an opportunity to discover the materials more thoroughly. A detailed analysis of this spectrum is typically used to determine the identity and quantity of gamma emitters present in a gamma source, and is a vital tool in radiometric assay.

A gamma ray spectrometer can record the emissions and plot them on the histogram of energy levels (most commonly measured in kilo to mega electron volt (keV to MeV) range. Since every different radioisotope has a unique gamma ray energy emission, this spectrum can be analysed to determine the type of gamma emitting radioisotopes present.

The main components of the device are: charge sensitive amplifier, pulse forming unit, microcontroller ATMega 16, serial port interface and PC.

Figure 1 shows the $^{241}_{95}Am$ Spectrum. The graphic interface is developed using program “C Builder”.

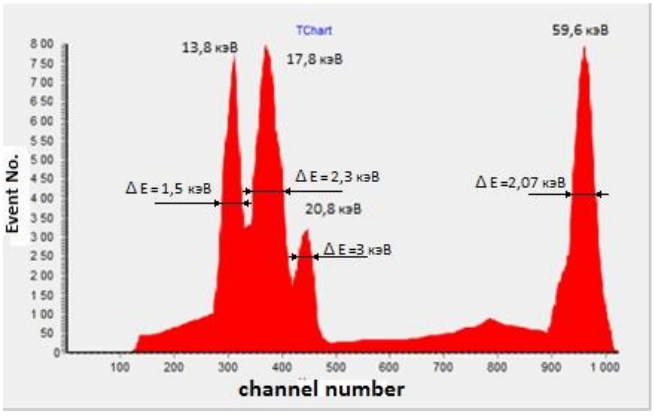

Fig. 1. $^{241}_{95}Am$ *Spectrum*

The designed portable spectrometer allows measuring low-energy gamma rays, electrons and alpha particles with reasonable accuracy.

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POTENTIAL APPLICATION OF ELECTROSPUN POLY (E-CAPROLACTONE) (PCL) NANOFIBERS FOR CONTROLLED RELEASE OF POORLY WATER-SOLUBLE DRUGS

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The targeted drug delivery and controlled release of poorly water-soluble drugs present state-of-the-art researches in nanomaterial science. It is caused, firstly, by the necessity of fast and safe release, secondly, by the necessity of high dosage connected with poor water-solubility. Biodegradable electrospun polymer PCL nanofibers seem to be very promising materials for this application [1, 2]. They have already demonstrated good results in experiments with ibuprofen and carvedilol [3]. The aim of our research is to make experimental samples of electrospun PCL nanofibers for paracetamol and to determine their potential as a novel delivery system for poorly water-soluble drugs.

For the preparation of polymer solutions polycaprolactone (PCL), paracetamol and hexafluoroisopropanol (HFIP) were used. For the preparation of (2 wt/%, 8 wt%, 16 wt%, 32 wt% based on the dry weight of the polymer) paracetamol-loaded PCL solutions previously dissolved in HFIP paracetamol powders were added to PCL granules and then refilled with the rest of the solvent. Electrospinning of nanofibers was proceeding on NANON – 01 (MECC CO., Japan) with a 200 mm diameter drum collector.

To determine the average diameter of the nanofibers SEM images were used. To study a drug release process scaffold’s elements were put into PBS-solution (pH 7.4) for two weeks, at the predetermined time points 200 µl of the solution was withdrawn and replaced with fresh phosphate buffer. Probes were analyzed by HPLC (Agilent 1200 Infinity, Agilent Technologies, USA). SEM imaging of the prepared electrospun scaffolds with an incorporated drug revealed rounded, individual nanofibers with a smooth surface without visible crystals. According to the obtained data a kinetic curve of paracetamol release was formed. The release from the PCL 16 wt/wt. % nanofiber scaffold was fast, reaching more than 97% of the total amount in the first hour.

The obtained results demonstrate that electrospinning can be used for the preparation of highly paracetamol-loaded PCL nanofibers. It is shown that incorporation of such poorly water-soluble drugs, as paracetamol in PCL nanofibrous material leads to their fast dissolution in pH-neutral medium. In conclusion, electrospinning is shown to be a promising approach to the delivery of poorly water-soluble drugs in order to control and enhance their release.

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