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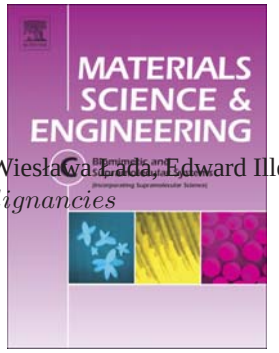

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^{90}Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies.

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Abstract

A new technology for the production of radiopharmaceutical ^{90}Y microspheres in the form of spherical yttrium oxide grains obtained by sol-gel method has been described. The authors present and discuss the results of investigations performed in the development of new production technology of yttrium microspheres and determination of their physic-chemical properties. The final product has the structure of spherical yttrium oxide grains with a diameter 25-100 µm, is stable and free from contaminants. Irradiation of 20 mg samples of grains with diameter of 20-50 µm in the thermal neutron flux of 1.7×10^{14} $cm^{-2}s^{-1}$ at the core of MARIA research nuclear reactor allowed to obtain microspheres labelled with the ^{90}Y isotope on the way of the nuclear reaction $^{89}Y(n, \gamma)^{90}Y$. Specific activity of irradiated microspheres has been determined by application of absolute triple to double coincidence ratio method (TDCR) and has been evaluated at 190 MBq/mg Y. ^{90}Y microspheres prepared by the proposed technique can be regarded as a promising medical material for radioembolization of liver malignancies.

Key words: sol-gel method, spherical yttrium oxide grains, nuclear reactor irradiation, yttrium-90 microspheres, dosimetry, radioembolization of liver malignancies.

Introduction

According to the global statistics relating to the diagnosed cases of liver malignant tumours there are 1 000 000 cases a year. Primary liver tumours (hepatocellular carcinoma HCC and cholangiocarcinoma) are among the most common. The methods used in the treatment of these tumours include surgical intervention, chemotherapy, radiotherapy. External radiotherapy and chemotherapy have an impact not only on tumour lesion but also on its extended neighborhood.

Liver is one of most important organs of the human organism. The vascularization of the liver is different from vascular systems of other organs. In the case of liver 70% of blood is supplied to it from the portal vein and only its insignificant amount is supplied via the hepatic artery. The discovery that arterial blood feeds liver malignancies allows to administer cytostatic drugs selectively as well as to apply the radioembolization technique consisting in introduction of radioactive microspheres in the area of the diagnosed cancer. Currently about 80000-10000 patients undergo radioembolization techniques around the world [1].

Selective internal radiotherapy (SIRT) with ^{90}Y-microspheres is an innovative, catheter-based method for treatment of malignant liver disease [2-5]. At the present time the SIRT is performed by injecting ^{90}Y resin or glass microspheres directly into the hepatic artery.