

Destruction of Colon Cells by Nanocontainers of Ferromagnetic

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Abstract : The aim of this work is to investigate the influence of electromagnetic field from the range of radio frequencies on the desired nanoparticles for cancer therapy. In the article, the development and demonstration of the method and the model device for hyperthermic selective destruction of cancer cells are presented. This method was based on the synthesis and functionalization of carbon nanotubes serving as ferromagnetic material nanocontainers. The methodology of the production carbon - ferromagnetic nanocontainers (FNCs) includes: The synthesis of carbon nanotubes, chemical, and physical characterization, increasing the content of a ferromagnetic material and biochemical functionalization involving the attachment of the key addresses. The ferromagnetic nanocontainers were synthesised in CVD and microwave plasma system. Biochemical functionalization of ferromagnetic nanocontainers is necessary in order to increase the binding selectively with receptors presented on the surface of tumour cells. Multi-step modification procedure was finally used to attach folic acid on the surface of ferromagnetic nanocontainers. Pristine ferromagnetic carbon nanotubes are not suitable for application in medicine and biotechnology. Appropriate functionalization of ferromagnetic carbon nanotubes allows to receiving materials useful in medicine. Finally, a product contains folic acids on the surface of FNCs. The folic acid is a ligand of folate receptors - α which is overexpressed on the surface of epithelial tumours cells. It is expected that folic acids will be recognized and selectively bound by receptors presented on the surface of tumour cells. In our research, FNCs were covalently functionalized in a multi-step procedure. Ferromagnetic carbon nanotubes were oxidated using different oxidative agents. For this purpose, strong acids such as HNO₃, or mixture HNO₃ and H₂SO₄ were used. Reactive carbonyl and carboxyl groups were formed on the open sides and at the defects on the sidewalls of FNCs. These groups allow further modification of FNCs as a reaction of amidation, reaction of introduction appropriate linkers which separate solid surface of FNCs and ligand (folic acid). In our studies, amino acid and peptide have been applied as ligands. The last step of chemical modification was reaction-condensation with folic acid. In all reaction as coupling reagents were used derivatives of 1,3,5-triazine. The first trials in the device for hyperthermal RF generator have been done. The frequency of RF generator was in the ranges from 10 to 14Mhz and from 265 to 621kHz. Obtained functionalized nanoparticles enabled to reach the temperature of denaturation tumor cells in given frequencies.

Keywords : cancer colon cells, carbon nanotubes, hyperthermia, ligands

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