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Influence of Iron Content in Carbon Nanotubes on the Intensity of Hyperthermia in the Cancer Treatment

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Abstract : The term ‘cancer’ is given to a collection of related diseases that may affect any part of the human body. It is a pathological behaviour of cells with the potential to undergo abnormal breakdown in the processes that control cell proliferation, differentiation, and death of particular cells. Although cancer is commonly considered as modern disease, there are beliefs that drastically growing number of new cases can be linked to the extensively prolonged life expectancy and enhanced techniques for cancer diagnosis. Magnetic hyperthermia therapy is a novel approach to cancer treatment, which may greatly contribute to higher efficiency of the therapy. Employing carbon nanotubes as nanocarriers for magnetic particles, it is possible to decrease toxicity and invasiveness of the treatment by surface functionalisation. Despite appearing in recent years, magnetic particle hyperthermia has already become of the highest interest in the scientific and medical environment. The reason why hyperthermia therapy brings so much hope for future treatment of cancer lays in the effect that it produces in malignant cells. Subjecting them to thermal shock results in activation of numerous degradation processes inside and outside the cell. The heating process initiates mechanisms of DNA destruction, protein denaturation and induction of cell apoptosis, which may lead to tumour shrinkage, and in some cases, it may even cause complete disappearance of cancer. The factors which have the major impact on the final efficiency of the treatment include temperatures generated inside the tissues, time of exposure to the heating process, and the character of an individual cancer cell type. The vast majority of cancer cells is characterised by lower pH, persistent hypoxia and lack of nutrients, which can be associated to abnormal microvasculature. Since in healthy tissues we cannot observe presence of these conditions, they should not be seriously affected by elevation of the temperature. The aim of this work is to investigate the influence of iron content in iron filled Carbon Nanotubes 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. The research work has been financed from the budget of science as a research project No. PBS2/A5/31/2013.

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