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BOOK OF ABSTRACT

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The occurrence of microbial biofilms is rather common in biomedical implants, such as joint prostheses, catheters, mechanical heart valves, pacemakers. Biofilms are matrices of extracellular polymeric substances produced by bacteria, containing one or multiple species of microorganisms (bacteria or yeasts). Such matrices are often responsible for the development of chronic infections. Indeed, they act as barriers to prevent antibiotics to reach bacteria, making biofilms highly resistant to antibiotic therapies[1]. From here, the need of developing new antibacterial strategies.

In this contest, in the last years, some studies suggested the employment of functionalized superparamagnetic iron oxide nanoparticles (SPION) as carriers for targeted drug delivery. Indeed, with respect to other nanoparticles, SPIONS have the advantage that they can be targeted to the infection site, and forced to penetrate the biofilm, by means of the application of a magnetic field[2]. Interestingly, in 2009 Taylor et al. reported that prosthetic biofilm formation would be prevented by the employment of not-functionalized SPION[3], although the origin of the highlighted antibacterial properties is nowadays matter of debate.

Here we present an experimental study carried out on SPION-rich-fibrin-hydrogels, with the aim of obtain a biocompatible hydrogel with intrinsic antibacterial properties. Fibrin is a physiological blood component, involved in hemostasis, resulting from the enzymatic action of thrombin on the protein fibrinogen. It is a versatile biopolymer, which combines different important properties such as biocompatibility, flexibility, adhesion. For its properties, fibrin is widely used as a scaffold in tissue engineering and as a sealing for implants in medicine and surgery[4]. In this study we produced hydrogels at different ratio of fibrinogen, thrombin and nanoparticles concentrations. The action of an applied magnetic field was investigated after and during the polymerization. Morphology of the hydrogels was investigated by means of scanning electron microscopy (SEM) and atomic force microscopy (AFM) measurements.

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#600 - Synthesis and characterization of a new insulin conjugated nanogel for biomedical application

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Insulin, a metabolic hormone involved in glucose metabolism, plays also a neuroprotective role in the central nervous system being able to revert the cytotoxic processes induced by $A\beta_{42}$,a peptide involved in Alzheimer's disease. To reach the brain insulin have to across the BBB therefore an additional delivery strategy results to be necessary. For these aim we performed an insulin conjugated nanogels (NGs-In). Nanogels (NGs) have a great potential in the development of “smart” nanocarriers for (bio)molecular drugs and contrast agent for bioimaging. They are formed by physically or chemically crosslinked polymer networks, characterized by a large and flexible surface available for multivalent bioconjugations. NGs can be produced with high yields and through-puts by pulsed electron-beam irradiation of dilute aqueous solutions of water-soluble biocompatible polymers. In this work, a carboxyl functionalized nanogel system (NG), generated by pulsed e-beam irradiation of a semi-dilute poly(N-vinyl pyrrolidone) (PVP) aqueous solution in the presence of acrylic acid, with an average diameter in the 60-70 nm range (PDI<0.3) was used as a substrate to generate chemically stable insulin-grafted PVP NGs. In particular, grafting was carried out using human insulin without (PVP-g-insulin) or with fluorescein isothiocyanate labeling (PVP-g-insulin-FITC). The hydrodynamic dimensions of NGs before and after grafting (“naked NGs” and “grafted NGs”) were investigated by Dynamic Light Scattering. For the biological application, as first step, we have evaluated the biocompatibility and immunogenicity of NGs, at different concentration, on neuroblastoma LAN5 cells and PBMCs. Moreover we have demonstrated the capacity of NGs to protect the insulin from protease action by a resistance proteinase assay. Finally, the biological effect and neuroprotection of NGs-In has been verified.

#601 - Phenol compounds as new materials for Electron Spin Resonance (ESR) dosimetry in clinical photon and electron beams

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In the last decades several research laboratories have shown an increasing interest aimed at extending the applicability of Electron Spin Resonance (ESR) dosimetry to radiotherapy with different types of radiation beams. ESR is a spectroscopic method for investigating the structure and dynamics of such paramagnetic species. Free radicals are known to be produced when a compound is irradiated with ionizing radiations. The concentration of radiation-induced free radicals is proportional to the energy released inside in the medium and this allows for dosimetric measurements through ESR technique which able to quantitatively determine the radical concentration.The use of alanine as a dosimetric material gave the possibility to apply ESR spectroscopy for high-dose standardization and dose control in radiation processing. The ESR dosimetric method has many advantages such as simple and rapid dose evaluation, the readout procedure is non-destructive, linear response of many organic and inorganic compounds. ESR detectors show a behavior that suggest possible applications for various kinds of beams used for radiation therapy. Nowadays, the most widely used organic compound as a dosimeter is the alanine. However, many researches are in progress with the aim at improving sensitivity of ESR dosimetry for doses much smaller than 1 Gy. More sensitive materials than alanine are needed to make the ESR dosimeter competitive with other dosimetry systems.
Our research group has started an investigation of the ESR response of some phenols compounds for possible ESR dosimetric applications suitable features, such as high efficiency of radiation-matter energy transfer and radical stability at room temperature. Phenols are compounds possessing a benzene ring attached to a OH group. After irradiation the final product is a stable phenoxy radical. The stability of such radical can be improved by adding other alkyl chains which can be attached to the benzene ring. In particular, the phenol *octadecyl-3-(3,5-di-tert.butyl-4-hydroxyphenyl)-propionate* gave interesting results. Moreover, its high molecular weight, the low volatility and the compatibility with the dosimeter binding material (wax) are advantages with respect to lower molecular weight phenols.
In this work we report the ESR investigation of phenols exposed to clinical photon and electron beams. The dosimetric features of these ESR dosimeters (dependence on microwave power and modulation amplitude, their response after gamma and electron irradiations, dependence on beam type and energy, the detection limits for both beam typologies, signal stability after irradiation) were investigated and the results are reported.

#602 - Evaluation of the effective resolution of an optical flatbed scanner for radiochromic films analysis

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In radiation dosimetry there are numerous problems associated with the measurement of isodose curves and depth-dose distributions in high-gradient regions using conventional measuring systems such as ionization chambers, semiconductors and thermoluminescent detectors (TLDs).
These difficulties have been overcame by the introduction of radiation dosimeter with high spatial resolution which does not require a special developmental procedure and gives permanent absolute values of absorbed dose with an acceptable accuracy and precision and ease of handling and data analysis: the radiochromic film. Radiochromic dosimeters color directly, do not require chemical processing and their color change indicates exposure to radiation. Image formation occurs as a polymerization process, in which energy is transferred from ionizing radiation, initiating color formation through chemical changes.
The radiochromic films, after being irradiated, can be scanned with a professional commercial optical flatbed scanner. In this way it is possible to obtain a calibration curve that links the blackening of the film with the absorbed dose. Gafchromic® films are undoubtedly the most widely used in most modern medical centers and they are divided into two main groups: films dedicated to radiotherapy (EBT2 and EBT3) and films dedicated to diagnostics group (the set of XR films). The main difference between them is that the former are analyzed with the flatbed scanner in transmission mode, the seconds in reflection mode. Although the maximum resolution of these films is often associated to the size of the activated monomers in the blackening process, the instrument that plays the main role is the optical scanner that captures an image of the film to associate with the absorbed dose. The resolution of a scanner is expressed in dpi (dot per inches), which expresses the number of dots printed or displayed on a line long one inch and is related to the amount of image information provided by a input device. For this reason, a study investigating the effective spatial resolution of commercial scanners used for radiochromic films has been conducted. For this purpose XR-QA2 films, specifically designed as a Quality Assurance (QA) tool for radiology in a process-less environment have been used. These films have a sensitivity range from 0.1 to 20 cGy, can be handled in room-light and have to be read in reflection mode with an optical scanner. The quantitative evaluation of the resolution of the scanner in reflective mode was performed with the theoretical method of the Modulation Transfer Function (MTF), that is useful in evaluating the performance of any optical device. In this way it was possible to compare the nominal resolution of the optical scanner with that experimentally evaluated, that depend on the combined properties of the light sensor, electronics, optics and mechanical components, and the protocol of image acquisition.