Poly(vinyl alcohol)-containing nanohydrids for biomedical applications

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Poly(vinyl alcohol) (PVOH) is a biocompatible and water-soluble polymer generally used as a hydrogel in various biomedical applications [1] such as drug-delivery systems, contact lenses and haemodialysis membranes.

Our group recently developed a technique for the preparation of well-defined poly(vinyl acetate) (PVAc), the precursor of PVOH by methanolysis, using the so-called Cobalt-Mediated Radical Polymerization (CMRP) of vinyl acetate [2]. With the aim of developing some new photosensitizers for photodynamic therapy (PDT), we investigated this CMRP technique for the preparation of PVOH/C_{60} nanohydrids. PDT is a cancer treatment involving the irradiation of a photosensitizer, thereby generating singlet oxygen ($^1O_2$), a cytotoxic species initiating tumor necrosis. Due to its high quantum yield of singlet oxygen production, C_{60} has been suggested as a potential photosensitizer for PDT [3]. Since a water-soluble and biocompatible photosensitizer is required, PVAc was prepared by CMRP and next grafted onto C_{60} by radical addition [4]. Methanolysis of the ester groups of PVAc/C_{60} led to the water-soluble PVOH/C_{60} nanohybrid that turned out to be an interesting candidate for PDT. Indeed, this nanohybrid produced significant amounts of $^1O_2$ and displayed toxicity towards human monocytic cells upon red light irradiation. The PVOH/C_{60} nanohybrid was also submitted to a protein absorption test (CH50 test) that revealed a significant activation of the complement system by the nanohybrid. Therefore, a protein-repellent polymer, namely poly(ethylene glycol) (PEG), was incorporated in the PVOH shell of the nanohybrid in order to improve its stealthy character. For such a purpose, the copolymerization of VAc with a PEG acrylate (APEG) by CMRP was investigated, followed by the grafting onto C_{60}.

In this presentation, the preparation of the stealthy nanohybrids and their photoactivity will be discussed. The key-role of the numerous hydroxyl functions of the PVOH/C_{60} nanohybrids for their post-functionalization by targeting agents (*e.g.* cRGD peptide) and/or anti-tumoral compounds will also be emphasized.

References:

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