SYNTHESIS OF WATER-SOLUBLE POLYMER-MODIFIED FULLERENES FOR CANCER PHOTODYNAMIC THERAPY

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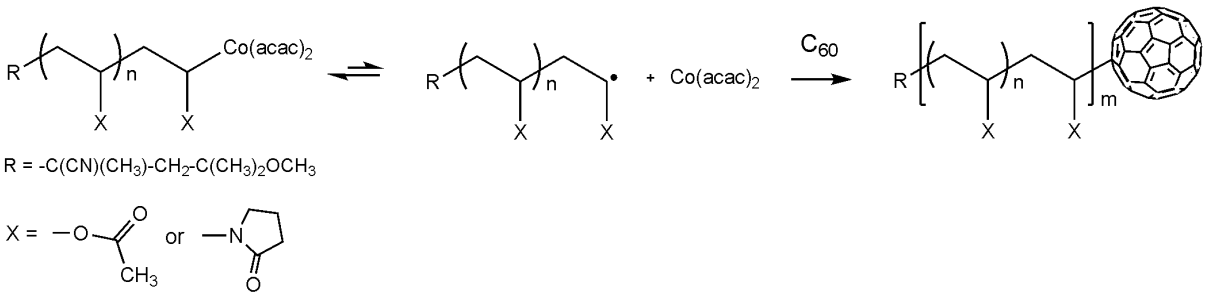
Photodynamic therapy (PDT) is a cancer treatment involving the irradiation of a photosensitizer that generates singlet oxygen ($^1O_2$), a cytotoxic species initiating tumor necrosis. Due to its high quantum yield of singlet oxygen production, C_{60} has been suggested as potential photosensitizer for PDT [1].

Since a water-soluble and biocompatible photosensitizer is required, poly(vinyl acetate) (PVAc) and poly(*N*-vinyl pyrrolidone)-*co*-poly(vinyl acetate) (P*N*VP-*co*-PVAc) polymers were prepared by cobalt-mediated radical polymerization (CMRP) [2] and next grafted onto C_{60} by radical addition (Scheme 1) [3]. The structure of the resulting nanohybrids was tentatively tuned by changing the [PVAc]/[C_{60}] ratio for the grafting reaction.



R = -C(CN)(CH$_3$)-CH$_2$-C(CH$_3$)$_2$OCH$_3$

X = —O— (O, CH$_3$) or —N— (O)

Scheme 1 : Poly(vinyl acetate) and poly(*N*-vinyl pyrrolidone)-*co*-poly(vinyl acetate) macroradicals grafting onto C_{60}.

Water-soluble poly(vinyl alcohol)/C_{60} (PVOH/C_{60}) nanohybrids, resulting of the methanolysis of the ester groups of PVAc/C_{60}, together with the P*N*VP-*co*-PVAc/C_{60} nanohybrids, are interesting candidates for PDT. Indeed, these nanohybrids produce significant amounts of singlet oxygen upon red light irradiation, as assessed by the ADPA bleaching test. Moreover, they turn out to be toxic towards human monocytic THP-1 cells upon red-light irradiation.

Finally, the key characteristic of these nanohybrids is the presence of many hydroxyl functions (or precursors) enabling their post-functionalization by targeting agents and/or anti-tumoral compounds that could increase the selectivity and the efficiency of the therapy.

References

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