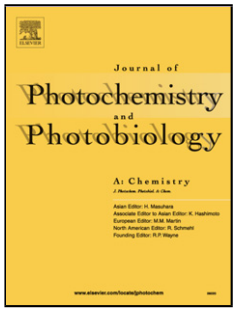

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Photodynamic properties and photoinactivation of microorganisms mediated by 5,10,15,20-tetrakis(4-carboxyphenyl)porphyrin covalently linked to silica-coated magnetite nanoparticles

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HighlightsPorphyrin was covalently linked to silica-coated magnetite nanoparticles.

- Singlet molecular oxygen was produced in water.
- Nanoparticles sensitized the photooxidation of L-tryptophan in water.
- Photosensitized inactivation of microorganisms was induced by nanoparticles.
- Nanoparticles were still efficient after three cycles of photoinactivation.

Abstract

Magnetic nanoparticles of Fe_3O_4 (MNP) were synthesized by co-precipitating Fe^{2+} and Fe^{3+} ions in an ammonia solution. This MNP was coated with silica using sodium metasilicate to obtain silica-coated MNP (MNPSi). Grafting of aminopropyl groups on MNP or MNPSi was performed with (3-aminopropyl)trimethoxysilane to form $MNPNH_2$ or $MNPSiNH_2$, respectively. 5,10,15,20-Tetrakis(4-carboxyphenyl)porphyrin (TCPP) was covalently bound onto the $MNPNH_2$ or $MNPSiNH_2$ via carbodiimide activation to obtain MNPNH-TPCC or MNPNH-TPCC, respectively. These MNP presented an average diameter of about 15 nm. UV-visible absorption spectra presented the characteristic Soret and Q bands of TCPP covalently linked to the nanoparticles. The MNP containing TCPP produced a high photodecomposition of 2,2-(anthracene-9,10-diyl)bis(methylmalonate), which was used to detect singlet molecular oxygen $O_2(^1\Delta_g)$ production in water. Moreover, these nanoparticles sensitized the photooxidation of L-tryptophan in water, mainly mediated by a type II photoprocess. Photoinactivation of microorganisms was investigated in