Enhancing Photodynamic Therapy for Melanoma: Nanoparticle Porphyrin Complexes

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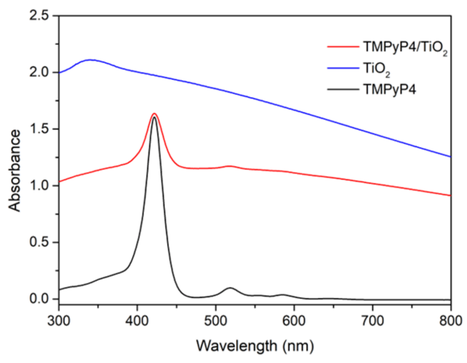
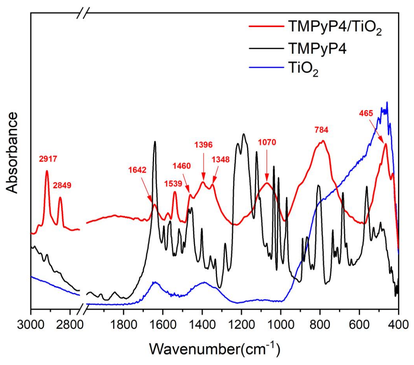
Outline

- **Photodynamic therapy (PDT) is focused on the generation of reactive oxygen species in diseased tissue by exposing it to light at a specific wavelength.**
- **The combination of nanoparticles and photosensitizers may offer significant advantages in photodynamic therapy PDT of melanoma, such as improved cell penetration, enhanced ROS production, and cancer selectivity.**
- **In this study, we investigated the photodynamic effect of 5,10,15,20-(Tetra-N-methyl-4-pyridyl)porphyrin tetratosylate (TMPyP4) complexes with TiO_2 nanoparticles and iron oxide γ-Fe2O3 nanoparticles, synthesized by laser pyrolysis technique, functionalized with 5,10,15,20-(Tetra-4-sulfonatophenyl) porphyrin tetraammonium (TPPS) on human cutaneous melanoma cells by irradiation with 1 mW/cm² blue light.**

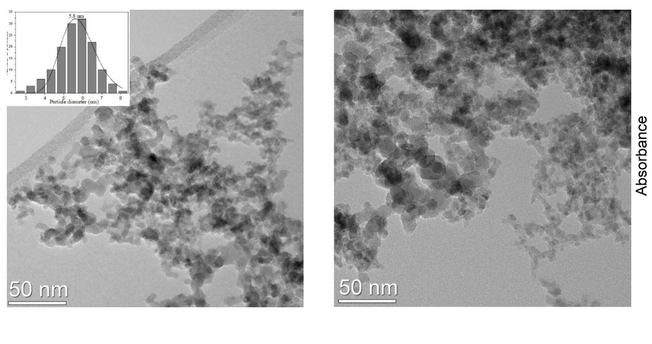
Physicochemical Analysis



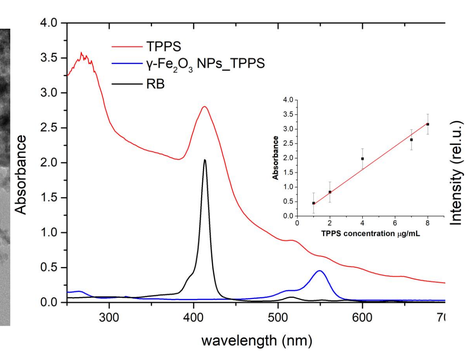
The absorption spectra for $TMPyP_4$ water solution, TiO_2, and TiO_2 NPs_$TMPyP_4$ suspensions.



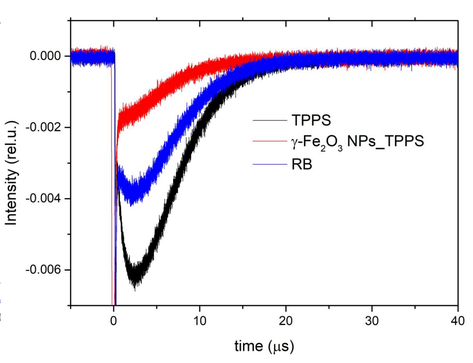
FTIR spectra of TiO_2 NPs, TMPyP4, and TiO_2 NPs_$TMPyP_4$.



TEM images of synthesized nanoparticles (left) and γ-Fe2O3 NPs_TPPS (right).

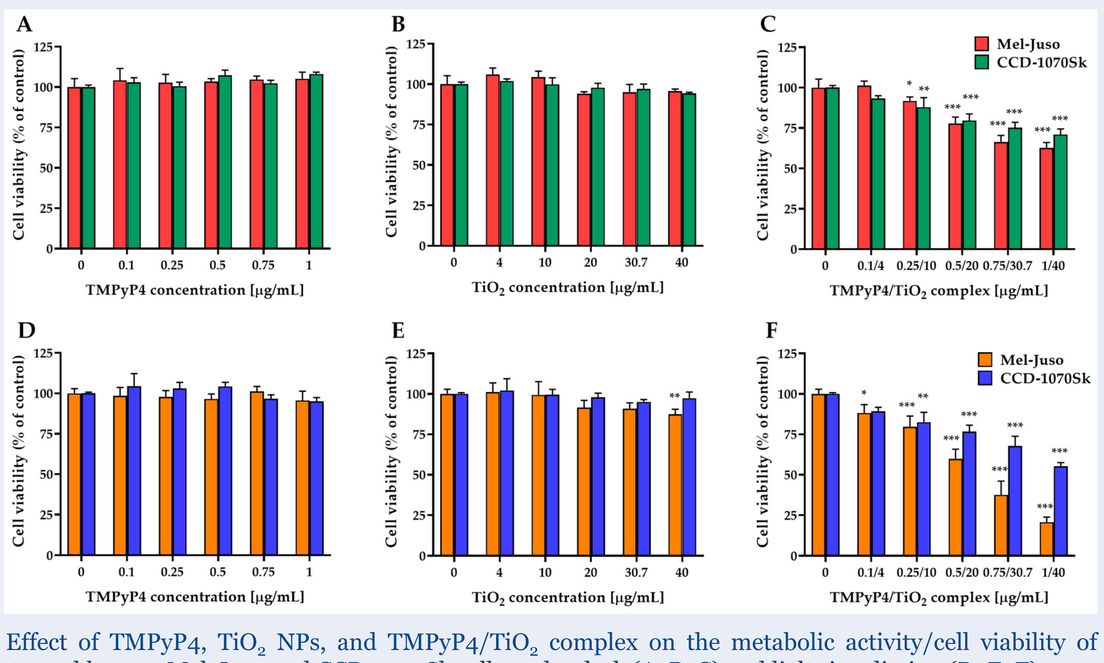


The absorption spectra of TPPS, γ-Fe2O3 NPs_TPPS and Rose Bengal.

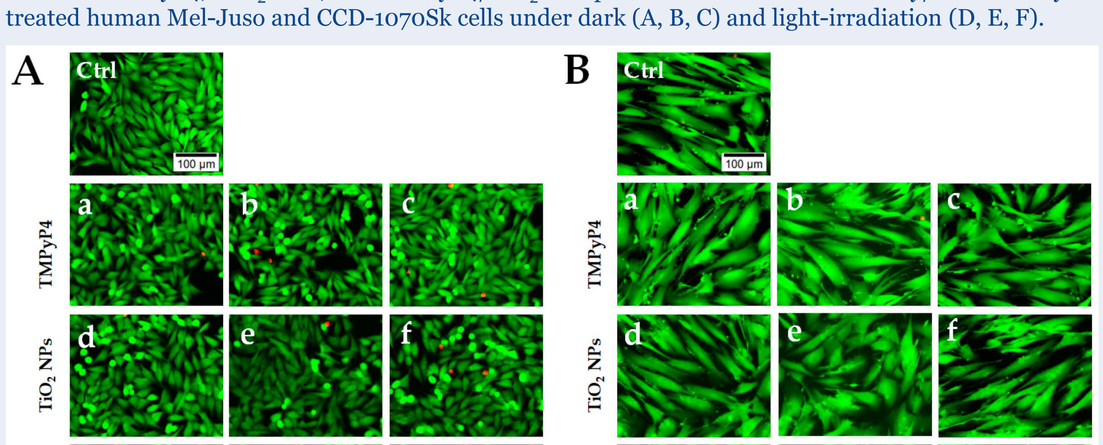


Time-resolved phosphorescence of singlet oxygen generated by the investigated samples.

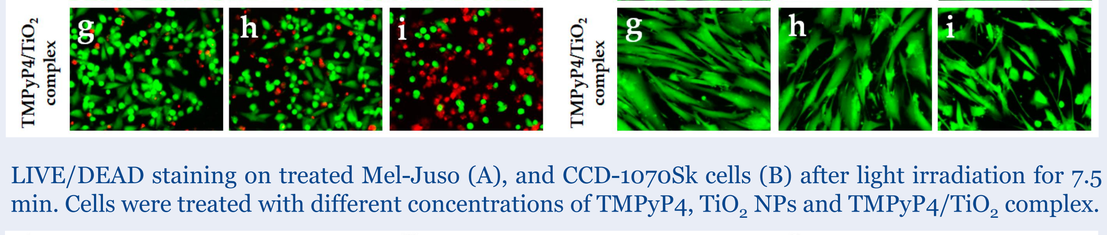
In vitro studies



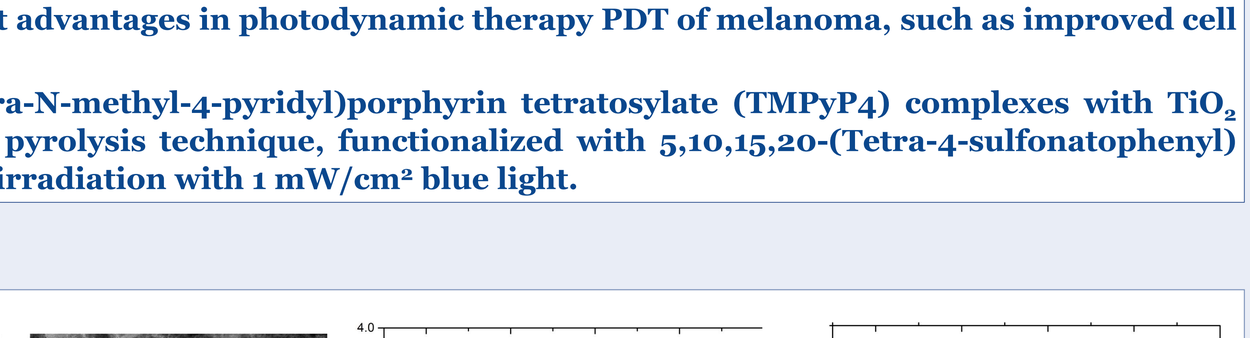
Effect of TMPyP4, TiO_2 NPs, and TMPyP4/TiO_2 complex on the metabolic activity/cell viability of treated human Mel-Juso and CCD-1070Sk cells under dark (A, B, C) and light-irradiation (D, E, F).



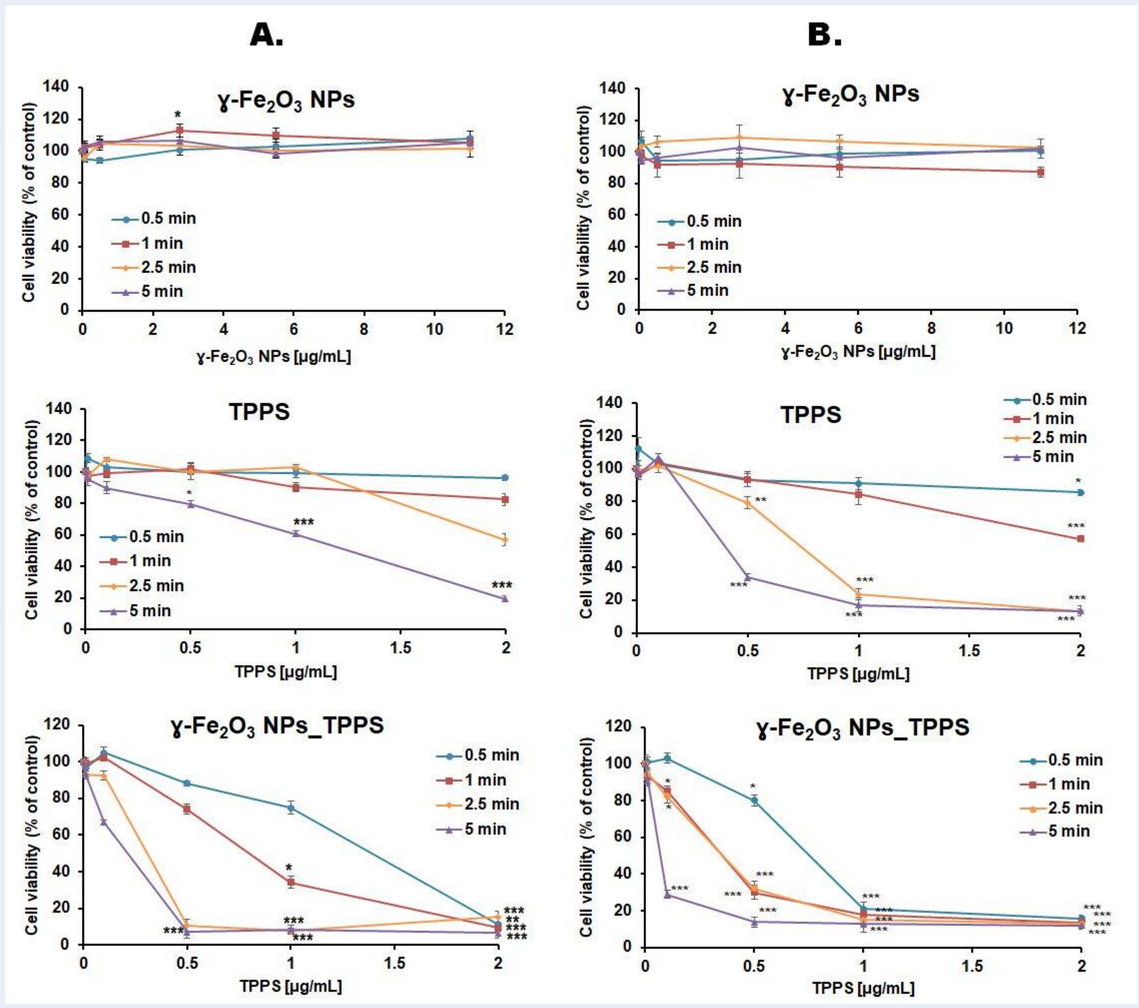
LIVE/DEAD staining on treated Mel-Juso (A), and CCD-1070Sk cells (B) after light irradiation for 7.5 min. Cells were treated with different concentrations of TMPyP4, TiO_2 NPs and TMPyP4/TiO_2 complex.



Effect of TMPyP4, TiO_2 NPs, and TMPyP4/TiO_2 complex on intracellular reactive oxygen species (ROS) production in cells under dark (A, B, C) and light-irradiation (D, E, F).



The effect of no irradiation vs. irradiation (405 nm, 1 mW/cm², 1 min) on morphology and viability of Mel-Juso cells. (A) Bright-field images after 24 h exposure to different concentration of investigated solution. (B) Cell viability of Mel-Juso cells after 24 h incubation with nanocomplexes at different concentrations.



Variation of Mell-Juso cell viability depending on irradiation time and treatment dose.

References

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- M Balas, S Nistorescu, MA Badea, A Dinischiotu, M Boni, A Dinache, A. Smarandache, A.M. Udrea, P. Prepelita, A. Staicu, Photodynamic Activity of TMPyP4/TiO2 Complex under Blue Light in Human Melanoma Cells: Potential for Cancer-Selective Therapy, *Pharmaceutics* **15**, 1194, 2023.

Take away

- This study proved the anti-tumoral effect of the synthesized porphyrin-loaded nanoparticles on human melanoma cells subjected to PDT by 405 nm LED irradiation. The loading efficiency of NPs with TPPS was estimated by using absorption spectroscopy.
- The FTIR spectra and TEM images evidenced the nanoparticles conjugation with porphyrins.
- The nanocomplexes showed a good efficiency for singlet oxygen generation determined by measurements of singlet oxygen phosphorescence at 1270 nm.
- The biological investigations showed a significant increase of porphyrin-loaded nanoparticles photodynamic activity for very low irradiation dose.

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