

Blue light-mediated photocatalysis for antibacterial photodynamic therapy (aPDT)

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When exposed to light, titanium dioxide (TiO_2) produces a cascade of radicals that can induce photodegradation in various targets such as biomolecules, bacteria, or biofilms: that's why TiO_2 -based materials are of great interest for biomedical applications. In bare materials, these reactions are triggered by UV light, which, as is well known, may induce toxic side effects and has limited penetration into tissues[1]. To overcome these limitations, synthetic methods with nitrogen doping have been used to modify the bandgap of the semiconductor[2]. We here present an experimental study by means of spectroscopy and microscopy methods aimed at the production, and characterization of nitrogen-doped TiO_2 (N- TiO_2) nanostructures and analyzing their photocatalytic activity in combination with gold nanoparticles (AuNPs) as suitable enhancers with well-known biocidal and tunable optical properties. N- TiO_2 nanostructures were shown to readily induce photodegradation of the model dye Methyl-orange in solution, under illumination with blue radiation (at 420 nm). Interestingly, the photocatalytic activity of these structures was demonstrated to be enhanced in the presence of AuNPs. A possible explanation of this result is that the inclusion of gold on the nanostructured surface of N- TiO_2 enhances the separation of photogenerated electron-hole pairs and increases interfacial charge transfer[3]. Studies are currently in progress to assess the photodegradation of biomolecules such as proteins and DNA, while preliminary studies on bacterial cultures demonstrate antibacterial activity following LED irradiation, making them suitable as photo agents for antibacterial photodynamic therapy (aPDT). More research is needed to properly study these processes in composite materials in which titanium and gold are included in hydrogels, nanofibers, or films with selected components to improve biocidal efficacy.

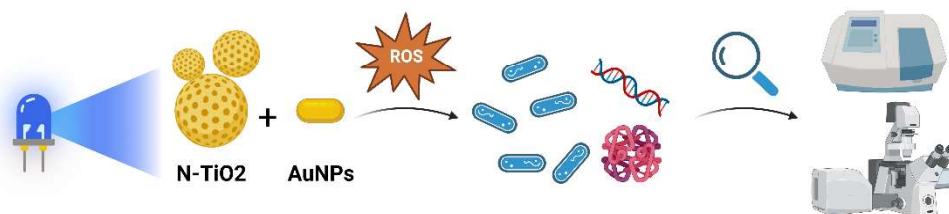


Figure: Graphical abstract

References

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