RobotsFun

Optical rechargeable Nanorobots for F ununga l Biofilm Eradication

Timeline | 09/2023 to 03/2025

ICIQ People | Villa Research Group

Budget | 40.000 €

Call | Becas Leonardo BBVA

SUMMARY

Candida species are the main cause of fungal infections in superficial skin and internal organs, leading not only to high morbidity and mortality rates, but also high healthcare costs (€1.5 billion per year). Current antifungal treatments include mainly drug-based procedures. However, considering that fungal microorganisms can form drug-resistant protective biofilms, there is an urgent need to develop alternative antifungal systems based on drug-free treatments. This project, **RobotsFun**, focuses on the use of photo-rechargeable nanorobots, composed of photocatalysts and luminescent materials, that can self-propel in the dark after initial light exposure for photodynamic antimicrobial therapy. As shown in the Scheme, the proposed mechanism for eliminating fungal biofilms includes the following steps: i) Pre-charging of the nanorobots with optical energy. ii) Self-propulsion of the photocatalytic/luminescent nanorobots in the dark, through an electron-charge transfer between both components. iii) The photoactivation of the nanorobots will result not only in their self-propulsion but also in the simultaneous release of reactive oxygen species (ROS). iv) Due to the high oxidizing power of ROS, these species will cause cell membrane disruption and DNA damage of fungal biofilms and cells.

RobotsFun involves an innovative approach combining energy storage, conversion, and release on a single nanorobot, without requiring constant light illumination, which will be explored for the first time for fungal biofilm inactivation inactivation. Furthermore, the outcome of this project will contribute to the development of more efficient nanotechnological strategies to combat fungal infections using drug-free systems.