Reunião Anual do INCT-FCx - 2022

De 26 a 29/Outubro de 2022,
Hotel Estância Atibainha, Nazaré Paulista/SP

Highly efficient ROS generation in carbon dots envisaging antimicrobial photodynamic therapy

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Abstract: The development of multifunctional nanomaterials, free of heavy metals, is a recurring subject in scientific community, with relevant results in the imaging of soft tissues, treatment against pathogenic microorganisms and creation of optoelectronic devices with less environmental impact. Recently, a remarkable attention has been devoted to the investigation of the interaction between nanoparticles and cellular media, focusing on the development of a new class of antimicrobial agents. The main reason is the growing of resistant strains of bacteria and fungi to traditional drugs, which increases the costs for the quality control of hospital environments. Within this context, the present study aims to the investigation of physicochemical properties of carbon quantum dots obtained from hydrothermal sinthesis, using the methyl red as the precursor. In particular, it is investigated the possibility of using carbon dots as photosensitizers in photodynamic dynamic therapy against pathogenic fungi and bacteria. In this case, the main goal is the study of nanoparticles exhibiting an efficient intersystem crossing between singlet and triplet excited states, which may favor the generation of reactive oxygen through energy transfer to oxygen molecules dispersed in the carrier medium. Our results reveal that carbon dots derived from methyl red exhibit a high efficiency in the generation of reactive oxygen species. Moreover, we study the antimicrobial activity of carbon dots against bacteria (*S. aureus* and *E. coli*) and fungi (*C. albicans* and *C. neoformans*) strains upon photoexcitation at 532 nm. By using the susceptibility test of Kirby-Bauer, so called disk diffusion test, we have observed that such carbon nanoparticles present an antimicrobial activity against gram-positive bacteria and fungi strains. The present findings indicate that carbon dots derived from methy red are promising materials for photosensitizer in antimicrobial photodynamic therapy.