Abstract

The increasing number of multidrug-resistant strains of bacteria call for alternatives to antibiotic therapy and, more generally, for the antimicrobial material as a component of prevention. Of particular interest is the photodynamic inactivation of bacteria and other pathogens caused by photogenerated singlet oxygen.

This work is focused on the field of photoactive polymer nanofiber membranes and nanoparticles, generating singlet oxygen, suitable for medical applications. We prepared different types of photoactive modified polystyrene nanofiber membranes with encapsulated or externally bound porphyrin photosensitizers. These materials efficiently produce highly reactive and cytotoxic singlet oxygen capable of restricted diffusion into to the external environment. Our results demonstrate the crucial role of wettability for materials of this type with a short diffusion length of generated singlet oxygen, illustrate the effect of temperature and indicate their potential use as multifunctional materials. Due to their antimicrobial properties, these materials are suitable alternative to antibiotics and local antiseptics. With good breathability and short diffusion length of singlet oxygen good results can be expect in *in vivo* tests.

From these nanofiber materials we also prepared photoactive extremely stable polystyrene nanoparticles with encapsulated photosensitizers that are effective for sterilizing/oxidation of a larger volume of aqueous solutions. We also presented method which is using nanoparticles for sensitive detection of oxygen in aqueous solution. The nanofiber material can be applied not only as source of nanoparticles but also as an effective filter for their removal from solution.