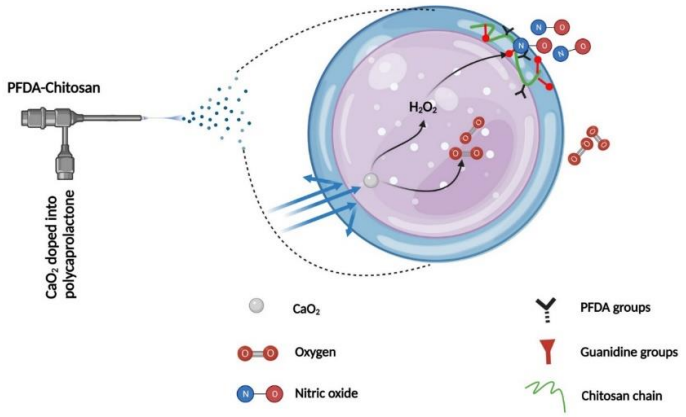
Synergistic oxygen and nitric oxide generation using core-shell particles

Chronic wounds in diabetics can be difficult to treat due to a complex and severe inflammatory microenvironment that includes biofilm formation, excessive reactive oxygen species (ROS), hypoxia, and insufficient nitric oxide (NO) synthesis. To address these challenges, we propose synthesizing core-shell particles that can generate both O2 and NO simultaneously and control their release rate to mitigate hypoxia and prevent infection. We hypothesize that by encapsulating calcium peroxide (CaO2) into polycaprolactone (PCL) particles, we can generate H2O2 and O2 gradually through a reaction with water. The produced H2O2 can then react with guanidine groups on chitosan to generate NO. Perfluorocarbon groups (PFCs) on chitosan will form an NO and O2 buffering shell that can trap excess gas release and release it in a controlled, sustained manner. To achieve this aim, several steps are required: A) Conjugating 40-45% PFC groups on the chitosan chain, B) Replacing the remaining amine groups of chitosan with guanidine groups through a chemical reaction, C) Synthesizing core-shell particles that generate and control the release of O2 and NO, D) Evaluating the kinetics of generated O2, H2O2, and NO from the particles, and E) Evaluating the physical and chemical properties of the developed materials. The proposed research aims to develop a novel approach to address the complex and severe inflammatory microenvironment in chronic wounds in diabetics using core-shell particles that generate both O2 and NO and control their release rate, potentially leading to improved healing outcomes.



The schematic illustration was created in Biorender.com

Related literature:

[1] C. Tu, H. Lu, T. Zhou, W. Zhang, L. Deng, W. Cao, Z. Yang, Z. Wang, X. Wu, J. Ding, Promoting the healing of infected diabetic wound by an anti-bacterial and nano-enzyme-containing hydrogel with inflammation-suppressing, ROS-scavenging, oxygen and nitric oxide-generating properties, Biomaterials 286 (2022) 121597.

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