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Perfluorocarbon Encapsulated IR780@Liposome for enhanced near-infra photodynamic antibacterial therapy against hypixia

Xiuhua Wang [a], Ziqiang Xu [a], Xiangmei Liu [b], Zhenduo Cui [b], Xianjin Yang [b], Kelvin W. K. Yeung [d], Paul K. Chu [c], Shuilin Wu [a,b]

[a] Hubei Collaborative Innovation Center for Advanced Organic Chemical Materials, Ministry-of-Education Key Laboratory for the Green Preparation and Application of Functional Materials, Hubei Key Laboratory of Polymer Materials, School of Materials Science & Engineering, Hubei University, Wuhan 430062, China

[b] School of Materials Science & Engineering, Tianjin University, Tianjin 300072, China

[c] Department of Physics and Materials Science, City University of Hong Kong, Hong Kong, China

[d] The University of Hong Kong, Hong Kong, China

Keywords: photosensitizer, reactive oxygen species, perfluorohexane, photodynamic therapy, antibacterial activity.

Introduction: Photodynamic antibacterial therapy (PDT) is a kind of therapy relay on the ability of converting oxygen around into cytotoxic singlet oxygen ($^1O_2$) to kill bacterium. It usually consist of three components: a photosensitizer (PS), light, and tissue oxygen. The light-activated PS transfers its excited-stated energy to the environmental oxygen for generating reactive oxygen species (ROS). However, antibacterial photodynamic theray is often limited by surrounding oxygen supply, in addition, there remains an inadequate oxygen capacity especially in tissue infected, and thus decrease the antibacterial activity. Perfluorohexane (PFH) nanodroplet has a high oxygen content that can enrich oxygen of photosensitizer around. Therefore, PFH can be used to form an oxygen self-enriching photodynamic therapy system which can not only overcome the problem of oxygen insufficiency but also prolong $^1O_2$ lifetime. Hence, we encapsulated perfluorohexne into a photosensitizer (IR780) loaded liposome film to fabricate an antibacterial platform and then observe its bacterium resistivity and cellular compatibility. And the antibacterial PDT efficiency is improved considerably in consequence.

Materials and methods: In order to estimate the morphology about the obtained nanostructure modified AHT Ti plates, using a scanning electron microscopy (SEM, JSM7100F and JSM6510LV) equipped with energy-dispersive spectroscopy (EDS) can get this purpose. The improvement of ROS generating is determined by H_2DCFDA which act as a fluorescent probe. *In vitro* responses of bacterial was evaluated by *S. aureus* and *E. coli*. *In vivo* responses of antibacterial activity was revealed by subcutaneous operations in rats.

Results and Discussion: The result illustrate that the photosensitizer IR780 and PFH were successfully encapsulated within in liposome , and considerable enhancement in $^1O_2$ generation was observed, Lip (IR780+PFH) modified AHT Ti plates shows good biocompatibility and preferable improvement in antibacterial operation compared with lip (IR780) modified liposome under near infrared irradiation.

Conclusion: In this study, by contrast with traditional methods, compositing photosensitizer and perfluorohexane successfully applied. In vitro and in vivo test demonstrate that Lip (IR780+PFH) is a promising biomedical material in resisting the bacterium. Due to its ability to generating ROS, when composite with PFH and lip film, the yield of reactive oxygen species and compatibility in cellular environment are improved significantly.

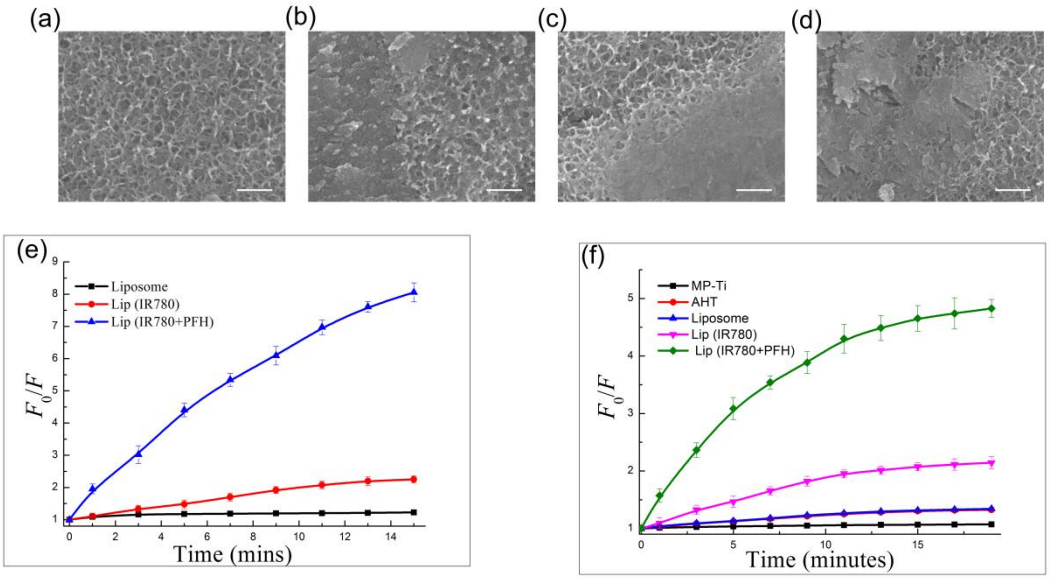

Figure: The morphology and microstructure and phase structure or composition is presented. a-d show the morphology of AHT Ti, Liposome, Lip (IR780), Lip(IR780+PFH). e-f show the $^1O_2$ production of Liposome, Lip (IR780) and Lip (IR780+PFH) in solution and on AHT Ti plates.

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Corresponding:

Email: shuilin.wu@gmail.com