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NIR-triggered thermosensitive polymer brush coating modified intraocular lens for smart prevention of posterior capsular opacification

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Abstract

Posterior capsule opacification (PCO) is the most common complication after cataract surgery. Drug-eluting intraocular lens (IOLs) is a promising concept of PCO treatment in modern cataract surgery. However, the large dose of drugs in IOL leads to uncontrollable and unpredictable drug release, which inevitably brings risks of overtreatment and ocular toxicity. Herein, a low-power NIR-triggered thermosensitive IOL named IDG@P(NIPAM-co-AA)-IOL is proposed to improve security and prevent PCO by synergetic controlled drug therapy and simultaneous photo-therapy. Thermosensitive polymer brushes Poly(N-isopropylacrylamide-co-Acrylic acid) (P(NIPAM-co-AA)) is prepared on IOL via surface-initiated reversible addition-fragmentation chain transfer (SI-RAFT) polymerization. Then, Doxorubicin (DOX) and Indocyanine green (ICG) co-loaded Gelatin NPs (IDG NPs) are loaded in P(NIPAM-co-AA) by temperature control. The IDG NPs perform in suit photodynamic & photothermal therapy (PTT&PDT), and the produced heat also provides a trigger for controllable drug therapy with a cascade effect. Such functional IOL shows excellent synergistic drug-phototherapy effect and NIR-triggered drug release behavior. And there is no obvious PCO occurrence in IDG@P(NIPAM-co-AA) IOL under NIR irradiation compared with control group. This proposed IDG@P(NIPAM-co-AA)-IOL serves as a promising platform that combines phototherapy and drug-therapy to enhance the therapeutic potential and medication safety for future clinical application of PCO treatment.

Keywords Posterior capsule opacification, Drug-phototherapy, Thermosensitive coating, Controllable drug release, SI-RAFT

Introduction

Cataract, an opacification of native lens, is still the leading global causes of reversible blindness and visual impairment [1, 2]. According to the results of the 2020 epidemiological study, it has affected 15.2 million people those aged 50 years and older, and is estimated to get worse due to a global aging [3, 4]. The only effective treatment for cataract is phacoemulsification cataract surgery (PCS) [5]. It involves a tiny corneal incision and replaces the native lens with an intraocular lens (IOLs) to restore clear vision. Unfortunately, despite the high success rate of PCS, there have been adverse postoperative outcomes

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