19p-D4-6

Liposome-silver Nanoparticles Hybrid as a SERS Traceable Drug Nanocarrier

Dan Zhu[1 *], Zhuyuan Wang[1], Shenfei Zong[1], Xin Wu[1], Yuwei Pei[1], Peng Chen[1], Xueqin Ma[1], Yiping Cui[1 **]

[1] Advanced photonics center, Southeast University, 2# Sipailou, Nanjing 210096, Jiangsu, PRC
*E-mail:zhudam@gmail.com; **E-mail: cyp@seu.edu.cn;

1, Introduction

Since its first discovery in 1961 by the British haematologist Bangham , the hollow lipid vesicle with a bilayer structure has gained widespread attention for its irreplaceable advantages, such as excellent biocompatibility and biodegradability. Researchers in fields of pharmacy and biophotonics have made intensive studies of the therapeutic applications and clinical utilities of lipids as drug carriers. However, there is a growing need to integrate imaging and therapeutic capabilities into a single drug carrier system. As a result, recently, the design of liposome–nanoparticle hybrid is proposed, which utilize different kinds of nanoparticles to functionalize the liposome, resulting in a multifunctional nanoplatform.

Here, liposome-silver nanoparticle hybrid was successfully fabricated for the first time. First, pH-sensitive liposome was prepared by modifying ordinary liposomes with a copolymer (poly(N-isopropylacrylamide-co-mehtacrylic acid-co-octadecyl acrylate)). The addition of copolymer gives the liposome pH sensitivity and stability. Afterwards, the liposome was coated with silver nanoparticles via an in situ growth method. These silver nanoparticles can provide the liposome with fine SERS enhancing ability. Next, calcein was used as a model drug molecule to test the drug release behavior of the proposed hybrid nanostructure. The results showed that the primary pH sensitivity was well retained. Since the liposome-silver nanoparticle hybrid can generate SERS signals, combined therapeutic and imaging functions were realized using such hybrids. We anticipate that this kind of liposome silver nano-hybrids could serve as noble and multifunctional platforms for biomedical applications.

2. Experiments and results

Methods

Liposomes were first prepared by the film hydration method. Lipid and copolymer were dissolved in chloroform and evaporated to form thin films. Then suitable buffers were added to generate the self-assembled lipid vesicles. Sonication and extrusion of the lipid vesicles were performed before the coating of silver nanoparticles. Next, silver nitrate and sodium borohydride were used for the in situ growth of silver nanoparticles. Finally, free silver nanoparticles were removed by centrifugation.

Results

The hybrids were characterized using a set of techniques, including UV-vis spectroscopy, dynamic light scattering (DLS), and transmission electron microscopy (TEM). The liposome-silver nanoparticle hybrid structure was clearly observed in TEM images. Comparing with the pure liposome, silver nanoparticles were apparently distributed on the surfaces of the hybrids. In order to check the pH sensitivity of the hybrids, calcein was encapsulated in the aqueous core of the liposomes. The results showed that the fluorescence recovered when the pH value decreased. Silver nanoparticles grown on the liposome surfaces were active as SERS substrate. SERS signals could be detected after Raman reporter was adsorbed, which could further be employed for SERS based imaging.

3. Conclusions

In this report, a new kind of pH sensitive and SERS active liposome-silver nanoparticle hybrids were successfully presented for the first time. Such hybrid nanoparticles provide dual functionalities and have a great prospect in biomedical applications.