界面活性劑葡聚醣披覆四氧化三鐵磁性奈米粒子之製備及其特性之研究

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摘要

將碳水化合物（Carbohydrates）或多醣化合物（Polysaccharide）當作磁性奈米粒子之披覆材料是特別普遍的，最主要是因為其生物相容之特性。葡聚醣（dextran）為目前最常使用之界面活性劑，原因在於其有較長之體內循環、無毒性且有較廣泛不同分子量。本研究主要目的為利用本實驗室開發之新穎 One-step 製備法將葡聚醣披覆於磁性奈米粒子表面，並探討合成條件及其特性、披覆葡聚醣之磁性奈米粒子之粒徑、披覆不同分子量之葡聚醣對其 SAR 值之影響等。由實驗結果，本研究獲致以下幾項初步之結論：一、磁性奈米粒子可利用磁性析出（magnetic decantation），加速磁性粒子沉降並將上層過量之有機溶劑析出，接著加入過量之去離子水，析出數次達到純化樣品之效果。然而，經 One-Step 合成途徑之葡聚醣（dextran）修飾之磁性奈米粒子，可均勻混合於去離子水中，無法經由磁性沉降或離心（溶劑為水）來洗滌溶液內過量的有機物與鹽類。因此需經由離心方式並配合使用有機溶劑來清除。二、One-step 製備法可同時合成出奈米粒子之殼（shell）與核（core）。殼為葡聚醣，核為磁性奈米粒子。在合成步驟上較為省時。三、經本實驗掃描式電子顯微鏡檢測結果與文獻結果比較，One-step 製備法有較窄之粒徑分布。品質相對較優，One-step 合成途徑中，Fe3+於水溶液中會形成 Fe-O-Fe bridge，因此先藉由 dextran 抓住 Fe3+，隨後加入 Fe2+與鹼液共沉時，可快速形成奈米粒子之核與殼並有效限制其粒徑成長。四、One-step 製備法有較小之 SAR 值，不同分子量分別為 48.1±7.3 W/g （MW=9,000-11,000）與 24.6±5.7 W/g （MW=64,000-76,000）。此部分 SAR 值較低於文獻值，改善的方法可使用兩步驟方法，事先將磁性奈米粒子製備好，與本實驗 One-step 製備法相較之下，可形成較為完整之晶體。如此可影響到 SAR 值特性之表現。從 EDS 分析結果中，皆未發現硼元素之存在，因此，得到與文獻相同之結果。

關鍵字：磁性奈米粒子、葡聚醣、比吸收率、掃描式電子顯微鏡、能量分散光譜儀

Preparation and Characteration of Fe3O4 Magnetic Nano-particles Conjugated with Dextran

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Abstract

On account of the biological compatibility of magnetic nanoparticle, it is especially common to use carbohydrates or polysaccharides as the coating materials. The dextran is the most commonly used surfactant now because it contains no toxicity, has a longer in vivo circulation and different molecular weight. This research aims at coating the magnetic nano-particles with dextrans by the one-step preparation method, which is newly developed by our laboratory, and tries to discuss its effect on the value of SAR through an inspection on its synthesis condition, the size of the particle which is covered with dextran, and the coating dextrans with different molecular weights.

Based on the experimental results, it may be concluded: First of all, we can use magnetic decantation as a way to accelerate magnetic nanoparticles in subsidence and to separate out the overdose of organic solvent on the surface layer. Then, we pour overdose of deionized water into it, and, for several times, separate out the materials which has reach the level of purified sample. However, the magnetic nanoparticles, which has gone through one-step conjugation process with the use of dextran, can be well mixed in deionized water, and cannot cleanse the overdose of organic materials and salt in aqueous with the use of magnetic subsidence or centrifugal process. Second, one-step preparation method can conjugate the shell and core of nanoparticle at the same time. The shell is dextran, and the core is magnetic nanoparticle. It will be more efficient and time-saving in conjugation. Third, the complexes in this study were examined by SEM photograpy to insure the qualities , it has a narrower distribution of nanoparticle size.

The qualification of particle appears to be better than others in the literatures . In one-step conjugation process, because Fe3+ forms Fe-O-Fe bridge in water, we make dextran capture Fe3+, and then, add Fe2+ inside and it subsides with base solution together. As a result, it can quickly form the shell and core of magnetic nanoparticle and limit the growth of size of nanoparticle. Fourth, one-step preparation method has a smaller value of SAR, each of the different molecular weight are 48.1±7.3 W/g (MW=9,000-11,000) and 24.6±5.7 W/g (MW=64,000-76,000) respectively. The value of SAR is lower than that has been provided by the literatures, and there is a way called two-steps method to improve this situation, to prepare magnetic nanoparticles in advance. Comparing with the one-step preparation method, the two-steps method can form a more completed

crystal, and this will have an better effect on the characteristic of the SAR. The element Boron coming from NaBH4 was not also found in EDS analysis.

Keywords：magnetic nanoparticles, dextran , specific adsorption rate (SAR)， scanning electron microscope (SEM)，energy dispersive spectrometer(EDS)