葡聚糖披覆四氧化三鐵磁性奈米粒子一階段與二階段合成路徑改良製備法之探討

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摘要

葡聚糖披覆四氧化三鐵磁性奈米粒子(dextran @ MNPs)已被廣泛使用在熱治療之研究。其相關特性如粒徑大小、比吸收率等亦受合成製備方法及流程所影響。本研究我們嘗試葡聚糖披覆四氧化三鐵磁性奈米粒子一階段與二階段兩種合成路徑製備法。一階段與二階段合成路徑主要不同在於二階段合成路徑法先製備出磁性奈米粒子，接著將殼披覆於核表面。兩種合成路徑製備法產物使用 x 光繞射儀(x-ray diffraction)、超導量子干涉磁量儀(superconducting quantum interference device magnetometer)與掃描式電子顯微鏡(scanning electron microscope)檢測，以探討相關特性之差異。四氧化三鐵磁性奈米粒子(MNPs)飽和磁量值和比吸收率分別為 4.3 emu/g 4.3emg/g 及 50.2±5.9 W/g。一階段與二階段兩種合成路徑製備法飽和磁量值約為 3.0 emu/g，但其比吸收率分別為 40.9 ± 6.7 W/g 和 48.1±7.2 W/g。一階段與二階段兩種合成路徑製備法其產物(dextran @ MNPs)粒徑大小分別為 9.3 ± 1.8 nm 及 20.3 ± 3.7 nm(葡聚糖與 Fe3+莫耳比率為 1: 27)。本研究發現葡聚糖披覆四氧化三鐵磁性奈米粒子二階段合成路徑製備法有較佳之熱治療應用特性。

關鍵字：磁性奈米粒子、熱治療、粒徑大小、比吸收率、葡聚糖

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A modified method of dextran-coated Fe^3O^4 magnetic nanoparticles by one-step and two-step synthetic pathways

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Abstract

Dextran coated magnetic nanoparticles (dextran@MNPs) have been studied in the field of hyperthermia. The characteristics of dextran coated magnetic nanoparticles, such as particle size and specific adsorption rate, can be affected by synthesis technique. In this study, we synthesized dextran@MNPs with one-step method and two-step method. The major difference between these methods is that two-step synthesis method has dextran existing in the synthesis of Fe3O4 MNPs. The complexes derived from the two methods were examined by X-ray diffraction, superconducting quantum interference device magnetometer and scanning electron microscope. The saturation magnetization values and specific adsorption rate (SAR) were investigated carefully. For MNPs, the values were 4.3 emu/g and 50.2±5.9 W/g, respectively; and those for dextran@MNPs (one-step and two-step synthetic samples) were approximate 3.0 emu/g and 40.9 ± 6.7 W/g, 48.1±7.2 W/g, respectively. The dextran @MNPs by one-step synthesis method had less saturation magnetization values and worse heating efficiency. The particle sizes of the dextran@MNPs synthesized with one-step pathway is 9.3 ± 1.8 nm; and those with the two-step route is 20.3 ± 3.7 nm. Our study demonstrates a modified method for dextran@MNPs which results in better characteristics.

Key Words: hyperthermia, magnetic nano-particles, dextran, specific adsorption rate (SAR), particle size