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RESEARCH ARTICLE

Feasibility of TEOS Coated $CoFe_2O_4$ Nanoparticles to a GMR Biosensor Agent for Single Molecular Detection

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Magnetic properties of 200 nm ferrimagnetic $CoFe_2O_4$ nanoparticles before and after coating with TEOS were explored and compared to soft ferrimagnetic $MgFe_2O_4$ nanoparticles (200 nm) to evaluate the feasibility as an *in-vitro* GMR SV (giant magnetoresistance spin-valve) biosensor agent for single molecular detection (SMD). It was found that the magnetic degradation (or variation) of TEOS coated $CoFe_2O_4$ and $MgFe_2O_4$ nanoparticles are dominantly affected by the chemical dispersion process, which is carried out in the oleic acid (OA), oleylamine (OL), or OA+OL surfactant, before starting major coating process. In addition, the TEOS coating thickness controlled by TEOS concentration and pH level in the buffer solution prominently influenced on the magnetic degradation of TEOS coated nanoparticles. According to the experimental analysis results, the magnetic degradation of TEOS coated nanoparticles is mainly attributed to the variation of particle dipole interaction caused by the degree of particle aggregation depending on TEOS coating process conditions. The TEOS coated $CoFe_2O_4$ nanoparticles exhibited a higher magnetic stability for a GMR biosensor agent, e.g., small variation of remnant magnetization, saturation magnetization and magnetic coercivity, than that of $MgFe_2O_4$ nanoparticles at the different coating process conditions. The physical and chemical analysis confirmed that this is primarily due to its higher magnetic anisotropy. The experimentally verified high biocompatibility as well as the stably maintained magnetic properties of TEOS coated $CoFe_2O_4$ nanoparticles demonstrate that $CoFe_2O_4$ nanoparticles can be considered as one of the promising ferrimagnetic nanoparticle sensor agent for an SMD GMR SV biosensor.

Keywords: $CoFe_2O_4$ Nanoparticles, TEOS (Silica) Coating, Magnetic Properties, Biosensor Agent Applications.

1. INTRODUCTION

For the last ten years, the interests on the application of magnetic nanoparticles and giant magnetoresistance (GMR) effects to the biomedicine and diagnostic biosensors have been dramatically increased due to their technical promises.[1–3] In particular, as the recent technical breakthrough relevant to the synthesis techniques of magnetic nanoparticles have been rapidly developed, various research approaches utilizing magnetic nanoparticles to the *in-vivo* as well as *in-vitro* applications such as hyperthermia agents, MRI contrast agents, cell repairing agents, drug delivery agents, and sensor agents for GMR biosensors are paid a huge attraction in the real clinics and biomedical related industries.[4–11]

Most of magnetic nanoparticles considered for a GMR biosensor agent so far are superparamagnetic nanoparticles. Although those are used in DNA counter, and BARC (Bead ARray Counter) due to their easy manipulation without any serious agglomeration and easy retrieval of magnetic stray field, an extremely small magnetic susceptibility limits to achieve a reasonably high SNR (Signal-to-Noise Ratio) and a high sensing stability for single molecular detection (SMD) applications.[2, 10–11] More seriously, coating with biocompatible molecules or metallic based materials on the surface of superparamagnetic sensor

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