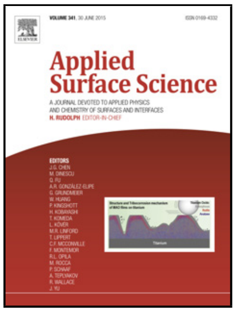
Accepted Manuscript



Title: Preparation and Characterization of Poly(glycidyl methacrylate)-grafted Magnetic Nanoparticles: Effects of the Precursor Concentration on Polyol Synthesis of Fe_3O_4 and $[PMDETA]_0/[CuBr_2]_0$ Ratios on SI-AGET ATRP

Author: Liping Jiang Xuyang Zhou Guyun Wei Xiaoduo Lu Weiping Wei Jianhua Qiu

PII: S0169-4332(15)02442-3
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2015.10.044
Reference: APSUSC 31525

To appear in: *APSUSC*

Received date: 20-3-2015
Revised date: 6-10-2015
Accepted date: 6-10-2015

Please cite this article as: L. Jiang, X. Zhou, G. Wei, X. Lu, W. Wei, J. Qiu, Preparation and Characterization of Poly(glycidyl methacrylate)-grafted Magnetic Nanoparticles: Effects of the Precursor Concentration on Polyol Synthesis of Fe_3O_4 and $[PMDETA]_0/[CuBr_2]_0$ Ratios on SI-AGET ATRP, *Applied Surface Science* (2015), http://dx.doi.org/10.1016/j.apsusc.2015.10.044

Preparation and Characterization of Poly(glycidyl methacrylate)-grafted Magnetic Nanoparticles: Effects of the Precursor Concentration on Polyol Synthesis of Fe_3O_4 and $[PMDETA]_0/[CuBr_2]_0$ Ratios on SI-AGET ATRP

Liping Jiang, Xuyang Zhou, Guyun Wei, Xiaoduo Lu, Weiping Wei, Jianhua Qiu*
State Key Laboratory Cultivation Base for the Chemistry and Molecular Engineering of Medicinal Resources, School of Chemistry and Pharmaceutical Sciences, Guangxi Normal University, Guilin 541004, P. R. China

Abstract: Polymer brushes based on poly (glycidyl methacrylate) (PGMA) have been successfully grafted from the surface of silica coated iron oxide (Fe_3O_4@SiO_2) nanoparticles via surface-initiated activators generated by electron transfer atom transfer radical polymerization (SI-AGET ATRP). The size of the nanoparticles could be adjusted from 7.3 to 9.6 nm by varying the precursor concentration of iron(III) acetylacetonate. The Fe_3O_4 nanoparticles possessed a highly crystalline structure, and the saturation magnetization of the as-prepared magnetite was strongly related to the particle size. Furthermore, the grafted PGMA content on the magnetic nanoparticles could be controlled by varying the ligand to transition metal ratio in a *N,N,N',N'',N''*-pentamethyldiethylenetriamine (PMDETA)/$CuBr_2$ catalyst system. The maximum grafted content was 23.1% at a ratio of $[PMDETA]_0/[CuBr_2]_0$ of =2:1.

Keywords: Fe_3O_4 nanoparticles; precursor concentration; poly(glycidyl methacrylate); surface-initiated AGET ATRP; $[PMDETA]_0/[CuBr_2]_0$ ratio

1. Introduction

Magnetite (Fe_3O_4) nanoparticles (NPs) have been developed for their fundamental scientific and technological interest including magnetic energy storage,[1] cell separation,[2] targeted drug delivery,[3] selective enrichment,[4] hyperthermia treatment,[5] and magnetic resonance imaging (MRI).[6] Control of the size and different morphologies (spherical, octahedral and cubic) of monodisperse Fe_3O_4 NPs is very important because these various structures generate distinct properties.[7] To understand magnetic behavior and to improve applications, careful research related to synthetic strategies and growth mechanisms of Fe_3O_4 NPs are essential.

There are many reports on the synthesis of Fe_3O_4 NPs using different preparation methods including co-precipitation,[8] hydrothermal reactions,[9] thermal decomposition,[10] flow injection syntheses,[11] and polyol process.[12] Of these, the polyol method is particularly attractive for the synthesis of hydrophilic nanoparticles. During preparation, the polyols often serve as reducing agents and high-boiling point solvents while also, stabilizing nanoparticle growth and preventing interparticle aggregation.[13] The metal precursor becomes solubilized in the diol form and forms an intermediate, which is then reduced to form metal nuclei that will nucleate and form metal particles.

The classic oleic acid-oleylamine polyol system was developed by the Sun group.[14-16] Oleic