Preparation of Hyperbranched Copolymer Grafted magnetic Graphene Oxide via RAFT-SCVP

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Abstract

Herein, a magnetic graphene oxide/hyperbranched copolymer nanocomposites (GO@Fe3O4@HPC) was prepared via RAFT-SCVP technique. Graphene oxide nanosheets were decorated with Fe3O4 nanoparticles, functionalized with 3-(trimethoxysilyl) propyl methacrylate (MPS) and then, hyperbranched of poly (NIPAM-co-AA) were successfully attached to the surface of magnetic graphene oxide.

Keywords: Magnetic nanosheets – RAFT-SCVP¬ – Hyperbranched – Copolymer – poly (NIPAM-co-AA).

1. INTRODUCTION

Hyperbranched polymers (HPs) have attracted significant attention due to their unique properties such as good solubility, low viscosity, reduced hydrodynamic volume, critical phase behavior, as well as having numerous terminal functional groups. These consequential properties make them very useful for a wide range of applications, including modification of materials, support system for catalysis, bioimaging agents, gene carriers, drug delivery devices, and dye encapsulation [1].

For preparation of different HPs, self-condensing vinyl polymerization (SCVP) is promising one, where polymerization of conventional vinyl monomers is carried out in the presence of a branching agent having both propagation and initiation ability. Branching agent employed for SCVP is typically an AB* "inimer" (also known as chain transfer monomer (CTM)), carrying both a polymerizable vinyl group (A) and an initiating substrate (B*). Recently, SCVP approach is generally carried out in combination with various controlled radical polymerization (CRP) techniques, such as nitroxide-mediated radical polymerization (NMP), atom transfer radical polymerization (ATRP) and reversible addition-fragmentation chain transfer (RAFT) polymerization. Combining this methodology, SCVP, with RAFT polymerization brings about control over branch length and polydispersity [2].

In the past few decades, graphene has attracted much attention due to its excellent properties. Graphene has a single layer two-dimensional (2D) plate-like structure that exhibits high surface area and good mechanical properties.

Recently, graphene and its nanocomposites have been used in different applications such as sensors, electronics, surface coatings, drug delivery, and bioapplications [3].

In the present work, a facile and effective route for grafting hyperbranched copolymer onto graphene oxide surface by RAFT-SCVP technique. Frist, ACDT (as a RAFT-CTM) was synthesized from a reaction between DDMAT and HEMA monomer which was subsequently used as a branching agent in RAFT polymerization. Then, in the presence of AA, NIPAM, and ACDT, hyperbranched copolymer grafted onto the surface of magnetic graphene oxide functionalized by MPS.

Experimental

Materials

DDMAT and magnetic graphene oxide were prepared according to the procedure reported by Pourjavadi et al [4]. Acrylic acid (AA), N-isopropyl acrylamide (NIPAM), 2- hydroxyl ethyl methacrylate (HEMA), AIBN, 4-dimethylamino pyridine (DMAP), N,N-dicyclohexyl carbodiimide (DCC), 3-(trimethoxylsilyl) propyl methacrylate (MPS), and all solvent purchased from Merck (Germany).