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SWELLING BEHAVIOUR OF HYDROGEL NANOCOMPOSITES BASED ON CARBOXYMETHYL CELLULOSE

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Abstract: In this work, swelling behaviour of a novel hydrogel nanocomposite based on carboxymethyl cellulose (CMC) was reported. Firstly, the hydrogel nanocomposite was synthesized via a simple solution graft copolymerization of acrylic acid (AA) and 2-acrylamido-2-methylpropanesulfonic acid (AMPS) monomers onto CMC in the presence of CdS quantum dots by using ammonium persulfate as an initiator and methylene bisacrylamide as a crosslinker. Then, the certain variables of the graft copolymerization (i.e. the monomers, the initiator, the crosslinker, CMC, $CdCl_2$, and Na_2S concentrations) affected on the ultimate water-swelling capacity were optimized in detail.

Keywords: Hydrogel; Nanocomposite; CMC; Acrylic acid; AMPS; CdS Quantum dots.

1. INTRODUCTION

Up to now, numerous applications of QD-polymer nanocomposites have been widely applied in light-emitting devices (LEDs) [1,2], solar cells [3,4] and photorefractive materials for optical data storage or optical amplification[5,6], since QD-polymer nanocomposites display both long-term luminescent stability and good flexible processability. However, as a practical point of view, it seems to be difficult to produce high-performance QD-polymer nanocomposites mainly due to the occurrence of luminescence diminishing or quenching of QDs during QDs constructing into polymer matrices.

Hydrogels as three-dimensional insoluble hydrophilic polymeric networks with additional functional groups can provide unique environments for in situ synthesis of metal nanomaterials, and provide shelter for their protection for further use. Hydrogels can absorb large quantities of water, causing them to swell, thereby offering an excellent milieu for reactions that take place in aquatic environments. So, in the present work, the swelling capacities of synthesized polymeric hydrogels were studied in detail.

2. EXPERIMENTAL OBSERVATIONS

The hydrogel nanocomposites were prepared via a simple free-radical copolymerization by simultaneous CdS quantum dots and superabsorbent network formation according to the following procedure. Firstly, certain amounts of CMC (2.0 g), acrylic acid (AA, 2.5 mL) and 2-acrylamido-2-methylpropane sulfonic acid (AMPS, 2 g) were added to a three-neck reactor equipped with a mechanical stirrer (RZR 2021, a three-blade propeller type, Heidolph, Schwabach, Germany), while stirring (300 rpm) for 30 min. The reactor was placed in a water bath preset at 80°C. After dispersing and homogenizing the mixture of CMC, AA, and AMPS certain amount of the initiator APS (0.1 g dissolved in 5 mL H_2O) was added to the reaction mixture. Then, appropriate amount of $CdCl_2$ (100 mL of 250 mg/L) and Na_2S (0.05 mol/L) were added into the solution. A yellow material was precipitated immediately and were collected, washed with ultra pure deionized water three times and dried at 70°C for 10 h in vacuum oven (Figure 1).