Abstract

Amphiphilic block copolymers (BCP) are gaining significant attention among academic and industrial communities because of their fascinating characteristics and wide applications. The properties of the amphiphilic BCPs can be tuned by adjusting the hydrophilic and hydrophobic chain length of the amphiphilic BCPs. Amphiphilic BCPs can be prepared via living polymerization, ring-opening polymerization and controlled radical polymerization. However, living and ring-opening polymerizations have some limitations, such as maintaining the extremely low temperature, high purity of solvents, monomers, and limitation of functional monomers. From this point of view, reversible deactivation radical polymerizations (RDRP) are the most versatile and widely used polymerizations technique for preparing amphiphilic BCPs. In this context, this thesis delineates the synthesis of different type of new amphiphilic BCPs via RAFT-mediated *PISA* polymerization in the emulsion. In this case, the different hydrophilic (2-(methcryloyloxy) ethyl ammonium chloride, 1-vinyl-2- pyrrolidone and 4-vinyl benzene sulfonate), hydrophobic (isobornyl acrylate and n-butyl acrylate) and functional (glycidyl methacrylate and 2-(acetoacetoxy) ethyl methacrylate) acrylates/methacrylates/vinyl monomers were used for polymerization. This thesis also reports the preparation of different amphiphilic BCPs/nanocomposites based on nanosilica, graphene quantum dots (GQDs), nitrogen-doped graphene quantum dots (N-GQDs) and polyhedral oligomeric silsesquioxane (POSS). In this thesis, the structural, morphological and mechanical properties of the BCPs and BCPs/ nanocomposites were investigated by ^{1}H NMR, TEM, SEM and nanoindentation (NINT) analyses. These kind of surfactant-free emulsions showed high conversion and low coagulum leading to high yield, indicating the industrial viability of this work. Furthermore, the prepared BCPs/nanocomposites were employed in different multifunctional smart coatings such as superhydrophobic, self-cleaning, self-healing, anti-icing, antimicrobial, antifogging, anticounterfeiting and fluorescent coatings. In addition, different kind of coating techniques like single-layer, bi-layer and layer-by-layer were also adopted to develop such multifunctional coatings. Moreover, the entire process was carried out in water making the coatings sustainable and environmentally friendly.

Key words: Amphiphilic BCPs, RAFT polymerization, *PISA*, emulsion, graphene quantum dots, nanocomposites, core-shell morphology, fluorescence, multifunctional coatings.