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Dual Thermoresponsive Polyzwitterionic Core-Shell Microgels and Study of Their Anti-Fouling Effect

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Abstract : Microgel, a smart class of material, has drawn attention in the past few years due to its response to external stimuli like temperature, pH, and ionic strength of the solution. Among them, one type of polymer becomes soluble, and the other becomes insoluble in water upon heating displaying upper critical solution temperature (UCST) (e.g., polysulfobetaine, PSB) and lower critical solution temperature (LCST) (e.g., poly(N-vinylcaprolactam, PVCL)) respectively. Polyzwitterions, electrically neutral polymers are biocompatible, biodegradable, and non-cytotoxic in nature, and presence of zwitterionic pendant group in the main backbone makes them stable against temperature and pH variations and strong hydration capability in salt solution promotes them to be used as interfacial bio-adhesion resistance material. Majority of zwitterionic microgels have been synthesized in mini- emulsion technique using free radical polymerization approach. Here, a new route to synthesize dual thermo-responsive PVCL microgels decorated with appreciable amount of zwitterionic PSB chains was developed by a purely water-based surfactant-free reversible addition–fragmentation chain transfer (RAFT) precipitation polymerization. PSB macro-RAFTs having different molecular weights were synthesized and utilized for surface-grafting with PVCL microgels varying the macro-RAFT concentration using N,N′-methylenebis(acrylamide) (BIS) as cross-linker. Increasing the PSB concentration in the PVCL microgels resulted in a linear increase in UCST but decrease in hydrodynamic radius due to strong intrachain coulombic attraction forces acting between the opposite charges present in the zwitterionic groups. Anti- fouling effect was observed on addition of BSA protein solution on the microgel-coated membrane surfaces as studied by fluorescence spectrophotoscopy.

Keywords : microgels, polyzwitterions, upper critical solution temperature-lower critical solution temperature, UCST-LCST, ionic crosslinking
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