Core-shell Polymeric Hydrogel Nanoparticles with Magnetic Property as Potentials in Targeted Delivery of Active agents

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During the past few years, due to their unique physical properties such as high mobility and rapid response, much work has been done on different kinds of polymer particles with different properties in the various fields of biochemistry and medicine [1,2]. A functional property is that magnetic nanoparticles can ensure at localized therapeutics in vivo by application of external static magnetic field at targeted region in the body [3]. Smart and viable materials that are responsive to external stimuli were in demand and have been developed in the past decade for fundamental studies and technological applications. The stimuli may include pH, temperature, ionic strength, magnetic fields, and so on. Poly(N-isopropylacrylamide) (P(NIPAM)) is one of the most studied thermoresponsive polymer that shows a limited temperature of solubilization in water, called Lower Critical Solution Temperature (LCST), around 32°C [4,5], can be exploited as temperature triggered drug releasing carrier.

In this investigation, thermo-sensitive core-shell particles of poly(acrylonitrile-co-N-isopropylacrylamide (p(AN-c-NIPAM)) encapsulating nanomagnetic ferrites (Fe₃O₄ and Fe₂O₃) particles by microemulsion polymerization utilizing ethylene glycol dimethacrylate (EGDMA) as crosslinker and ammonium persulfate (APS) as initiator were synthesized. The particles were characterized by Transmission Electron Microscopy (TEM) and Dynamic Light Scattering (DLS). To increase the hydrophilic nature of the particles, the hydrophobic core monomer, AN was converted to the amidoxime group by amidoximation reaction and the conversion was confirmed by FT-IR. Ferrite nanomagnetic particles were prepared separately by chemical precipitation method and were included inside core of the polymeric nanoparticles. A calcium channel blocker, verapamil, was used as a model drug for the release studies from p(AN-c-NIPAM), amidoximated p(AN-c-NIPAM) and composite p(AN-c-NIPAM) particle systems in vitro in phosphate buffer solution at two different temperatures, at room T. (~25°C) and 40°C (> LCST: Lower Critical Solution Temperature of p(NIPAM)), respectively. In addition to NIPAM as shell materials, monomers with different functional groups and different charges were also utilized for the shell materials in hydrogel particle preparation and investigated for potential drug delivery devices.