Thermoresponsive PNIPAM/Fe₃O₄ polymer microcapsules

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The aim of this work is to prepare composite microcapsules consisting of thermoresponsive poly-N-isopropylacrylamide (PNIPAM) and Fe₃O₄ magnetic nanoparticles. Iron oxide nanoparticles and polymer PNIPAM are building blocks of the shell and the core, respectively. The particles are prepared via inverse Pickering emulsion polymerization. Thermoresponsive polymer PNIPAM changes both volume and the hydrophilic/hydrophobic transition at the lower critical solution temperature (LCST) of approximately 32°C. Below the LCST the amide groups of the polymer interact with water molecules which have impact in the polymer swelling. Above the LCST the interaction breaks off and the result is a de-swelling up of the polymer.

Iron oxide Fe₃O₄ nanoparticles have a good induction heating behaviour in the presence of alternating magnetic field (AMF). The self-heating of the particles is the result of Brownian or Néel relaxations, with the faster one being predominant. Néel relaxation is the reorientation of the internal magnetisation vector within the particle. On the other hand Brownian relaxation is related to the rotation of the entire particle.

The shell is made from the Fe₃O₄ nanoparticles in order to effectuate “remote control” of the hydrogel volume change. The composite microcapsule PNIPAM/Fe₃O₄ has a potential to be used as a micro-carrier for various active substances, like drugs or antibacterial agent (silver nanoparticles).