Multiphase change materials for nanostructured energy storage technologies - NEST

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The building sector is currently responsible for approximately 40% of final global energy consumption and CO_2 emissions. One promising technology that has emerged as a significant method by which energy consumption could be reduced is through the use of phase change materials (PCMs). However, commercially available PCMs are only able to function at fixed phase transition temperatures and therefore unable to be tuned to different melting temperatures, which limit their flexibility for multiple applications. This research was therefore intended to develop novel microencapsulated multiphase change materials (MCMs). The initial approach covered characterization of appropriate core PCMs and shell materials for the fabrication of the MCMs. The fabrication process was based on in-situ polymerization method as well as other processes covering synthesis of pre-polymer solution, preparation of oil-in-water (O/W) emulsion and formation of shells. Melamine-formaldehyde (MF) solution was used as shell monomers, nano- silicon dioxide hydrosol as emulsifier for reducing interfacial tension in the O/W emulsion and ammonium chloride as a nucleation agent for reducing the pH level and thus enabling the PCMs capsules to be crossed-linked with the MF polymer. Finally, the van der Waal interaction process was applied to produce the MCMs. Characterization of the developed samples were carried out through particle size analysis, differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) and scanning electron microscopy (SEM). It is believed that the technology could significantly reduce the material content, cost, size and ultimately payback period of integrated nanostructured energy storage components for other sectors such as pharmaceutical and the electronic industries.

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