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Carbon nanotube coated magnetic carbonyl iron microspheres prepared by solvent casting method and their magneto-responsive characteristics

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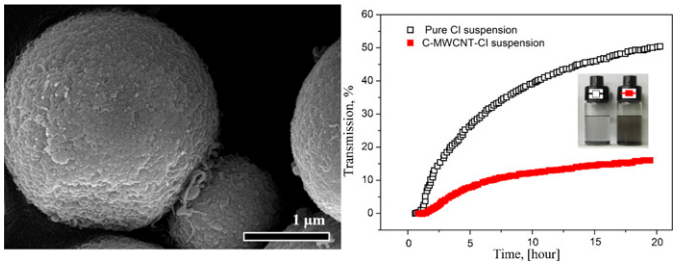
HIGHLIGHTS

- MWCNT was coated onto magnetic carbonyl iron via self-assembly forming core/shell structure.
- Ultrasonication was adopted to enhance MWCNT coating.
- Magnetorheological performance along with sedimentation was examined showing improved characteristics.

GRAPHICAL ABSTRACT



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ABSTRACT

In order to improve not only the magnetorheological (MR) properties of soft magnetic carbonyl iron (CI) but also its dispersion stability, we fabricated a dense network of multi-walled carbon nanotubes (MWCNTs) on the surface of CI particles by using 4-aminobenzoic acid as a grafting agent through a two-step method: ultrasonication and solvent casting, based on the self-assembly of MWCNTs which have a similar density to the polymer but better magnetic properties due to the iron catalyst located in the MWCNT. The influence of coating layers on magnetic properties along with MR performance such as yield stress behavior and shear viscosity were investigated by a vibrating sample magnetometer and rotational rheometer. The suspension stability was found to be improved from a Turbiscan test.

1. Introduction

A smart and intelligent fluid named as a magnetorheological (MR) fluid is capable of being solidified with an aid of an external magnetic field and re-liquefied by removing the magnetic field [1–3]. This phenomenon of solidification of the MR fluids with a magnetic field can be attributed to the formed columns, which are aligned along the direction of the magnetic field. Undoubtedly, robust chain-like structure will lead to a superior MR effect. Therefore, the suitability of dispersed particles being applied for MR fluids becomes crucial to affect the MR performances. During this abrupt state-changing process, the MR fluids exhibit distinct rheological characteristics, such as significant enhancement of yield stress and shear viscosity as well as storage modulus, along with their electrically analogous electrorheological (ER) suspensions under external electric fields [4,5]. Therefore, these smart MR fluids have great perspectives in designing diverse high performance engineering products including damper active systems, torque transducer and MR polishing equipments [6–9].

As MR particles, plenty of magnetic materials as well as their alloys [10–12] have been explored for the advanced engineering applications of MR fluids. Among them, soft magnetic carbonyl iron (CI) microbeads are considered to be excellent candidates for MR fluids due to their superior magnetic properties and suitable size

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