Magnetic Iron Oxide Nanoparticles for Magnetic Particle Imaging
Technology #17354

Applications

Magnetic particle imaging (MPI) is a tomographic imaging technique in which superparamagnetic, iron oxide nanoparticles are injected into the bloodstream, generating magnetic fields that are measured to produce 3D images. The inventors have developed monodisperse and highly magnetic large iron-oxide nanoparticles to increase the MPI signal strength.

Problem Addressed

MPI offers more advanced imaging than other commonly used techniques such as magnetic resonance imaging (MRI), with high sensitivity and resolution along with near-perfect contrast due to the diamagnetic nature of human tissue. MPI signal strength and efficiency are dependent on the synthesis and size control of large magnetic nanoparticles. Theoretical simulations predicted that the currently used commercial MPI contrast agent, Resovist®, has a limited signal strength similar to that of 3% iron oxide nanoparticles with a 30 nm inorganic diameter or above. However, the synthesis of superparamagnetic iron oxide nanoparticles in the ≥ 30 nm domain is challenging and rarely reported. To this end, the inventors have developed monodisperse and highly magnetic 35 nm iron oxide nanoparticles that are expected to improve the existing MPI signal strength of Resovist® by over 90%.

Technology

These large magnetite (Fe₃O₄) magnetic nanoparticles are prepared by decomposing iron oleate precursors at high temperature (290°C – 390 °C). The high reaction temperature encourages the formation of larger nanoparticles. Upon completion, the nanoparticles are precipitated by adding chloroform and acetone, centrifuged, and re-dispersed and stored in hexane.

The resulting ~35 nm iron oxide nanoparticles become water soluble upon deposition of a hydrophilic silica shell. The silica shell is formed on the surface of nanoparticles by decomposing tetraethyl orthosilicate (TEOS) in a cyclohexane solvent in the presence of Igepal CO-520 and ammonium hydroxide. The resulting iron oxide/silica shell nanoparticles have an inorganic diameter of ~50 nm and can be dispersed in water and various aqueous buffers. The nanoparticles are coated by polyethylene glycol derivatives such as methoxy polyethylene glycol silane to improve their long-term stability in aqueous media.

Advantages

- 35 nm iron oxide nanoparticles demonstrate > 90% increased MPI signal strength compared with Resovist®
- Particles display good stability in aqueous media
Categories For This Invention:

Materials  
Micro & Nanotech  
Nanomaterials  
Life Sciences  
Imaging

Intellectual Property:

Nanoparticles for magnetic particle imaging applications  
PCT  
2016-077769  
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