Synthesis and process scale-up for superparamagnetic iron oxide nanoparticle in MRI application

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The major purpose of this study is to develop an efficient and stable process for superparamagnetic iron oxide nanoparticle synthesis, which is the contrast agent for magnetic resonance imaging (MRI). In order to get a short T2 relaxation time, iron oxide nanoparticle with superparamagnetism was suggested in literature. Key issues of this process including particle size, particle size distribution, magnetism, coercivity, yield and batch to batch variation. In the industrial point of view, yield and batch to batch variation is as important as other characteristics mentioned above. Iron oxide nanoparticle was synthesized in a semi-batch stirred reactor by co-precipitation method with oleic acid as surfactant and the final product was dispersed in toluene for further utilization. Polyethylene glycol with xylene modification was used to replace oleic acid on the surface of iron oxide. After surface modification, iron oxide was extracted to water and the relativity was measured. The final scale-up result was obtained with 20 liter stirred reactor with the aid of computational fluid mechanic modeling. The average yield of this process was 14.12 g/batch, with an average hydraulic particle size of 18.02 nm; average saturated magnetism of 73.03 emu/g, average coercivity of 1.21 Hc, and average yield of 8.86%. For the purpose of industrial practice, standard deviation of all above properties measured was less than 10%. The r2 relativity parameter of the nanoparticle was up to 172 sec\(^{-1}\) with a r1/r2 ratio of 6.64. In-vivo MRI test was also conducted on rats with agreeable results.

Biography

Mu-Jen Young has completed his Ph.D. from Nation Tsing-Hua University in 2002. He has been involved in MRI contrast agent project of ITRI since 2006. The major effort of his work was in the topic of SPIO synthesis and process development. He is also author of 18 journal papers and 31 conference papers.