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FCT FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA

Chemistry Department

Mass transfer enhancement by functionalized magnetic nanoparticles

Systems Biology and Engineering Group

SBE Systems Biology and Engineering Group · bpeg biochemical and process engineering group · requimte rede de química e tecnologia · LSRE Laboratory of Separation and Reaction Engineering · Universidade do Porto FEUP Faculdade de Engenharia

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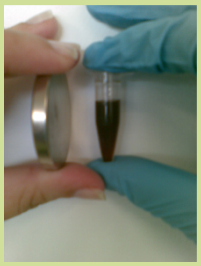
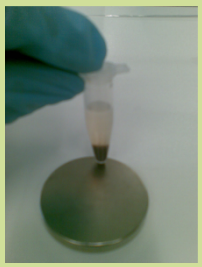
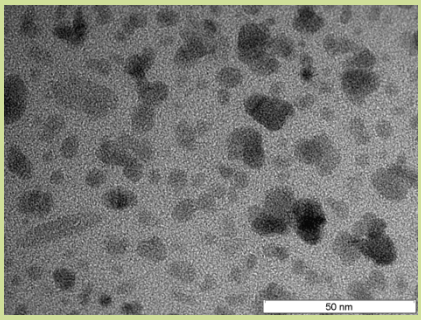
- **2007, M.Sc. Chemical and Biochemical Engineering**
- **Scientific articles: 2**

Objectives

The central goal of this study was to develop functionalized magnetic nanoparticles (FMP) to enhance oxygen transport in bioprocesses and provide insight on mass transfer mechanisms using magnetic nanoparticles. An improved magnetic nanoparticles synthesis protocol and purification technique was developed which yields a higher impact of nanoparticles of mass transfer when compared to the highest mass transfer report to date in oxygen transport systems.







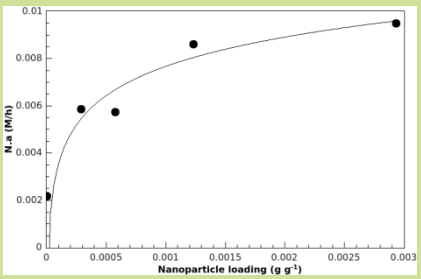
Methodology

Synthesis and purification of functionalized magnetic nanoparticles:
- Silica coating, Oleic acid coating, Oleic acid + Hitenol BC coating

Characterization of magnetic nanoparticles:
- TEM, DLS, Zeta-Potential, ICP, elemental composition

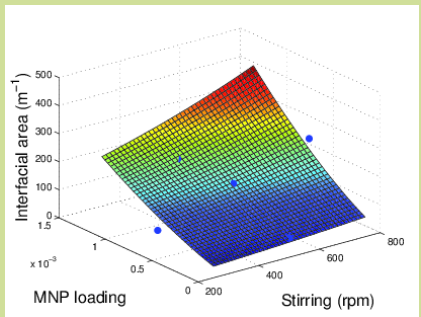
Experimental design for the analysis of k_La and a enhancement
- Reactor stirring: 250-750 rpm and 400-1400 rpm, Aeration: 0-2 vvm, FMP mass fraction: 0-0.12%

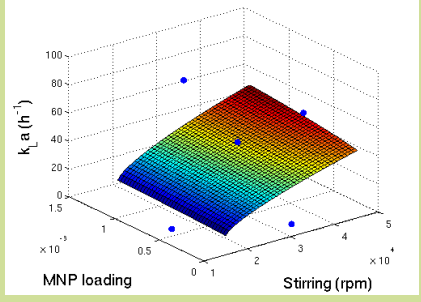
Modeling of results and comparison with literature correlations.



Expected Results

- It was found that our 36nm-sized nanoparticles enhance mass transfer coefficient up to 8.9-fold and the interfacial area up to 10.8-fold.
- The results showed higher enhancement than the literature (k_La enhancement of 7.1-fold and a enhancement of 4.1-fold).
- FMP showed to be stable (constant diameter) for wide range of pH (2-9), which is critical for use in bioprocesses.
- Correlations for both k_La and a were derived with a good agreement (under 10% error).





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