Synthesis of Iron oxide nanoparticles using natural rubber latex

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Introduction: Magnetic nanoparticles have attracted much research over the recent years due to their potential interests in a variety of biomedical applications. They possess an increasing relevance as diagnostic and therapeutic tools, such as, contrast agents in MRI, magnetic particle imaging (MPI), drug delivery and hyperthermia. Magnetic nanoparticles for biomedical applications should comply with a variety of requirements including: (i) superparamagnetic behavior at room temperature, in order to avoid particle aggregation; (ii) large saturation magnetization, so as to show a large response under the application of a magnetic field; (iii) a limiting size in the order of 20 nm for in vivo applications, and (iv) bio-compatibility, such that nanoparticles are usually coated with either biological or bio-compatible molecules. In this work, natural rubber latex (NRL) extracted from H. *brasiliensis* was used to cover magnetic nanoparticles and stabilizing agents.

Methods and materials: Iron oxide nanoparticles were synthesized by co-precipitation method. They were prepared by mixing ferric and ferrous ions in a 1:2 molar ratios in highly basic solutions (NH_4OH) with different amounts of natural rubber latex (NRL). Four solutions prepared at fixed Iron (II), (III) chloride content and different NRL volumes of 100, 200, 400 and 800 µL. The synthesis is very simple, inexpensive, and fast and occurs at room temperature. The colloidal particles can be used and stored in their liquid form or even as a powder or film obtained by drying the starting solution.

Results and discussion: The average size and particle size distribution of prepared magnetic nanoparticles were measured by employing Transmission Electronic Microscope (TEM), X-ray Diffraction (XRD), and dynamic light scattering (DLS). In all analysis it has been seen, that the average size and the size distribution of magnetic nanoparticles are influenced by the NRL volume. By increasing the NRL volume, the size distribution become narrower, also the size of nanoparticles gets smaller. The sample with 100 and 200µL exhibited larger polydispersity rather than 400 and 800 µL. Two important functions the cis-isoprene molecules or proteins in NRL can have influence in the growth and passivation of the particles. They act as a capping agent, thereby avoiding agglomeration of the nanoparticles and they become more homogenous and smaller.

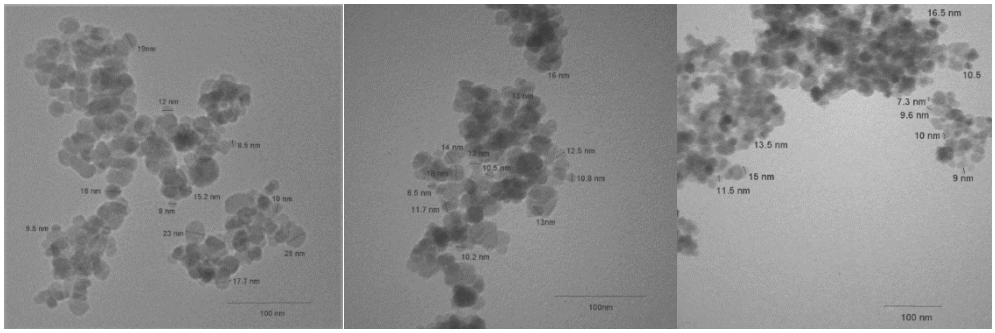

Figure 1. TEM images of Iron oxide nanoparticles for the different Latex volumes: (a)100 µL; (b)400 µL; (c)800 µL

Table 1. Size of prepared samples in different NRL volumes

Sample name	NRL (µL)	TEM (nm)	XRD (nm)	DLS (nm)
S1	100	15 ± 5.3	10.33	190
S2	200	-	10.44	141
S3	400	13.3 ± 2.5	9.64	122
S4	800	12.2 ± 2.1	9.17	91

Conclusion: Iron oxide nanoparticles with latex cover were synthesized. By increasing the amount of latex, the average size of nanoparticles became smaller and size distribution got more uniforms. In addition, XRD patterns showed magnetic nanoparticles with latex cover are more stable than the naked ones after nine months. So, latex can be considered as an effective stabilizing agent for biomedical applications.

Acknowledgments: CNPq and FAPESP for partial financial support