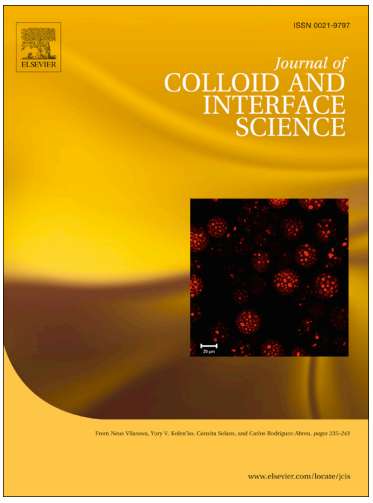

Rotational diffusion of magnetic nanoparticles in protein solutions

Ana C. Bohórquez, Chuncheng Yang, Donald Bejleri, Carlos Rinaldi

PII: S0021-9797(17)30771-3
DOI: http://dx.doi.org/10.1016/j.jcis.2017.07.009
Reference: YJCIS 22538

To appear in: *Journal of Colloid and Interface Science*

Received Date: 1 May 2017
Revised Date: 30 June 2017
Accepted Date: 2 July 2017

Please cite this article as: A.C. Bohórquez, C. Yang, D. Bejleri, C. Rinaldi, Rotational diffusion of magnetic nanoparticles in protein solutions, *Journal of Colloid and Interface Science* (2017), doi: http://dx.doi.org/10.1016/j.jcis.2017.07.009

ROTATIONAL DIFFUSION OF MAGNETIC NANOPARTICLES IN PROTEIN SOLUTIONS

Ana C. Bohórquez[1], Chuncheng Yang[1], Donald Bejleri[1], and Carlos Rinaldi[1,2]

[1]J. Crayton Pruitt Family Department of Biomedical Engineering, University of Florida, 1275 Center Drive, Biomedical Sciences Building, Gainesville, FL USA 32611; [2]Department of Chemical Engineering, University of Florida, 1030 Center Drive, Gainesville, FL USA 32611

Corresponding authors: ana.bohorquez@ufl.edu (A.C. Bohórquez), chunchengyoung@gmail.com (C. Yang), donbeu@gatech.edu (D. Bejleri), and carlos.rinaldi@bme.ufl.edu (C. Rinaldi)

Abstract

The rotational diffusion of polyethylene glycol coated magnetic nanoparticles in serum albumin solutions was investigated in a range spanning 0 mg mL^{-1} to 200 mg mL^{-1}. Rotational diffusivities were determined from dynamic magnetic susceptibility measurements, which provide a non-optical means to probe rotation of nanoparticles in small volume samples. Experimental rotational diffusivities were compared to those estimated using the Stokes-Einstein relation and macroscopic measurements of the viscosity of the protein solutions. Excellent agreement was found between experimental measurements and theoretical predictions for serum albumin solutions buffered at physiological pH and for serum albumin solutions at acidic pH prepared using simple acids and at physiologic ionic strengths. For serum albumin solutions prepared using citrate buffer at acidic pH, we observed a discrepancy between the experimental rotational diffusivity and that predicted from the Stokes-Einstein relation. In contrast, when the pH was adjusted with a simple acid and salt at physiologic ionic strength we observed agreement between the experimental rotational diffusivity and that predicted from the Stokes-Einstein relation. Because of the role of citrate ions in causing protein aggregation, we believe these observations suggest that dynamic magnetic susceptibility measurement of the rotational diffusivity of the nanoparticles is sensitive to gelation/crosslinking of proteins.

Keywords

Magnetic nanoparticles, protein solutions, bovine serum albumin, rotational diffusion, Stokes-Einstein relation, dynamic magnetic susceptibility

Abbreviations

BSA, bovine serum albumin; DMS, dynamic magnetic susceptibility; PEG, polyethylene glycol; MNP, magnetic nanoparticle; A-NB-NS, acidic unbuffered non-salted condition; A-NB-S, acidic unbuffered