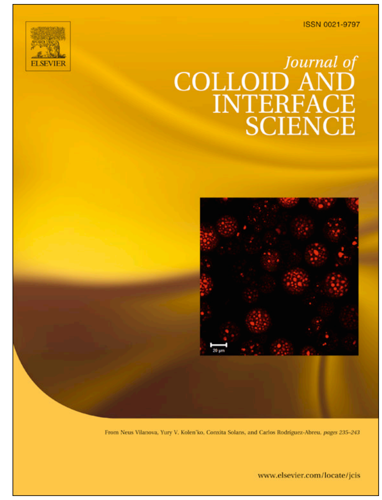
Accepted Manuscript

Regular Article

Assembling Particle Clusters with Incoherent 3D Magnetic Fields

Rasam Soheilian, Hamed Abdi, Craig E. Maloney, Randall M. Erb



PII: S0021-9797(17)31339-5
DOI: https://doi.org/10.1016/j.jcis.2017.11.036
Reference: YJCIS 23023

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

Received Date: 10 October 2017
Revised Date: 9 November 2017
Accepted Date: 11 November 2017

Please cite this article as: R. Soheilian, H. Abdi, C.E. Maloney, R.M. Erb, Assembling Particle Clusters with Incoherent 3D Magnetic Fields, *Journal of Colloid and Interface Science* (2017), doi: https://doi.org/10.1016/j.jcis.2017.11.036

Assembling Particle Clusters with Incoherent 3D Magnetic Fields

Rasam Soheilian[1], Hamed Abdi[1], Craig E. Maloney[1], and Randall M. Erb[1,*]

[1]Northeastern University, Department of Mechanical and Industrial Engineering, Boston, MA, USA
*r.erb@neu.edu

ABSTRACT

Directed assembly of particle suspensions in massively parallel formats, such as with magnetic fields, has application in rheological control, smart drug delivery, and active colloidal devices from optical materials to microfluidics. At the heart of these applications lies a control optimization problem for driving the assembly and dissolution of highly monodisperse particle clusters. For magnetic field control, most attention to-date has been centered around in-phase coherent magnetic fields. Instead, we investigate a family of incoherent 3D magnetic fields that are capable of creating controlled and tunable particle assemblies such as dimers, trimers, and quadramers. These field functions can be tuned to assemble monodisperse clusters with long term stability and can quickly switch the clusters between different states. This subset of three-dimensional field functions that we have studied demonstrates the rich phase space available to tune colloidal suspensions with magnetic fields.

Keywords: magnetic assembly; incoherent fields; colloids; directed assembly.

1. Introduction

Manipulation of particle suspensions with external fields has attracted lots of attention recently due to its potential applications in optics[1-3], rheology[4,5], and microfluidics[6,7]. Compared with electric, optical and acoustic fields, magnetic fields can deliver remarkable forces and torques while providing a facile platform to apply complex field functions in three dimensions with computer controlled solenoids[8]. Still, in the past few decades, most effort has focused on