

Structure Dynamics and Heterogeneity in Soft Materials
Determined by FRAP
JOEL HAGMAN
Department of Chemical and Biological Engineering
Chalmers University of Technology

Abstract

A common interest in industry today is to be able to control the mass transport inside soft (bio) materials in order to tailor both release and uptake of substances. Most of the materials used are heterogeneous, quite often multiphase or compound materials and often undergo dynamic changes; it is therefore important to have control over the local microstructure in order to tailor the macro scale properties. The work in this thesis expands the toolbox of available techniques for studying diffusion in such materials. This has been achieved by enhancing the usability of a technique called fluorescence recovery after photobleaching (FRAP) as well as by performing FRAP measurements in dynamic and heterogeneous materials. FRAP is an optical technique capable of measuring locally at a micrometer scale in a material sample. The results obtained have given an increased understanding of the structure--mass transport relationship. The technique has been improved by improving the accuracy of the mass transport determination, by reducing the required measurement area, by increasing the range of available materials in which FRAP can be used as well as by analysing the impact of probe selection. The materials used in this thesis work have been used as model materials for FRAP development and at the same time been investigated using FRAP. The materials, along with the key interest, can be summarized to the following choices: K-carrageenan for the structural heterogeneity, gelatin for the dynamic changes during gelation, gelatin/maltodextrin multiphase samples for the possibility to tailor the domain sizes, super absorbing polymers (SAP) for the possibility to alter the mass transport properties depending on the swelling and both β -lactoglobulin and pasta was used as model material for spatial correlation measurements of FRAP data. These results may be used for improved understanding of other materials as well and the FRAP technique is shown to be one promising tool when tailoring new structures.

Keywords: *Fluorescence recovery after photobleaching, Confocal microscopy, Structure dynamics, Soft materials, Heterogeneity*