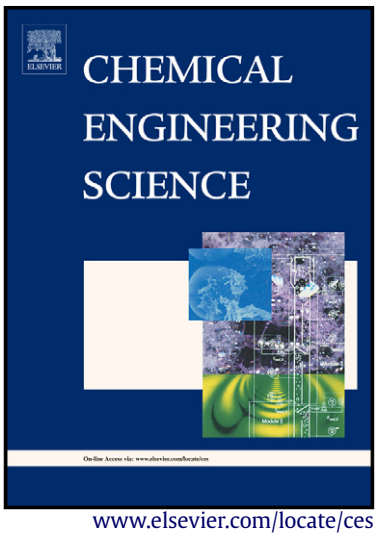

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Experimental investigation of liquid foams by polarised light scattering technique via the Mueller matrix

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Abstract

Experiments were conducted using well-controlled bubble size-distributed foam stabilised by SDS (Sodium Dodecyl Sulphate) solution to investigate the individual effect of liquid fraction of foam on the six independent normalised Mueller matrix elements via polarised light scattering technique. The liquid fraction, bubble size distribution and the Mueller matrix elements were measured individually during a foam free drainage process. It was found that the effect of foam properties on the Mueller matrix was more obvious when the foam was in a static state. Under the circumstance that the bubble size distribution was kept almost constant during the drainage process, the six independent normalised Mueller matrix elements showed dependence on the liquid fraction except N_{34}, whereas N_{22} and N_{33} showed the highest sensitivity. In addition, N_{12} and N_{44} exhibited reflection symmetry in the static stage during foam draining. This suggests that only five independent Mueller matrix elements are sufficient to represent the current foam because of its axisymmetry.

Keywords: Polarised light; Foam; Liquid fraction; Bubble; Bioprocessing; Flotation

1 Introduction

Liquid foams are randomly-packed bubbles with a small amount of liquid. They have wide applications in a variety of fields such as aerated food industry, personal care products, enhanced oil recovery, fire fighting, waste water treatment, mineral flotation and various other separation processes (Prud'homme and Khan, 1996). It is widely accepted that the quality of foam products and the efficiency of these processes involving foams are closely linked to bubble size distribution and the liquid fraction which are two of the most important parameters of foam (Narsimhan and Ruckenstein, 1986; Weaire and Phelan, 1996). Therefore, in order to better understand and control foam properties, many techniques have been developed to measure these parameters (Ekserova and Krugliakov, 1998). In terms of bubble size measurement, the following methods have been employed: photographic-image analyse, photoelectric sensor probe (Du et al., 2001), optical tomography (Fetterman et al.,