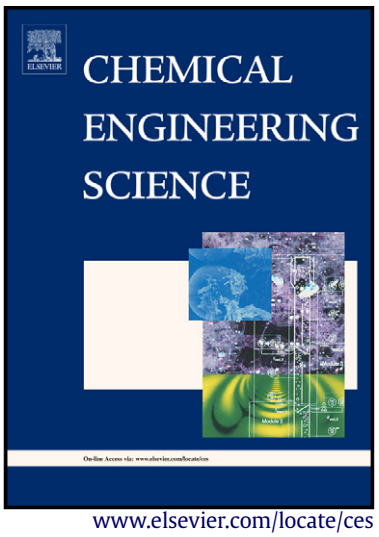




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# Real Time Monitoring of the Quiescent Suspension Polymerisation of Methyl Methacrylate in Microreactors - Part 1. A Kinetic Study by Raman Spectroscopy and Evolution of Droplet Size

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**Abstract**

This paper presents an experimental study on the polymerization of droplets of methyl methacrylate (MMA) in quiescent state using microreactors. The reaction kinetics was monitored by Raman spectroscopy, while the images of MMA droplets image were captured by CCD (charge-coupled device) camera within a micro-capillary. Different experimental recipes were proposed with commercial initiators in order to compare the system performance with two types of initiators: monofunctional and bifunctional peroxides. It is shown in this paper that the Raman technique is able to monitor the reaction kinetics at different conditions. For the first time in the open literature it was possible to identify the evolution of the monomer droplets during polymerization to high conversions ($> 90$ %) in quiescent state. In addition, it was possible to identify three different stages during the polymerization reactions of MMA. Finally, it is shown that the dispersities ($\overline{M}_w/\overline{M}_n$) obtained with the bifunctional initiator were lower than 2, while the dispersities obtained with the monofunctional initiator were greater than 2.

*Keywords:* microreactors; suspension polymerization; Raman spectroscopy; methyl methacrylate; kinetics; bifunctional initiator



## 1. Introduction

The usage of microreactors has increased steadily in the chemical engineering field (Ehrfeld et al., 2000; Jensen, 2001; Pattekar and Kothare, 2004; Sun et al., 2008; Chang et al., 2004; Iwasaki and Yoshida, 2005; Richard et al., 2013) and also in other areas of study (Zhang et al., 2004; Salic et al., 2012; Massignani et al., 2010). The application of this technology has been proposed originally in order to allow for small-scale production and became a reality in the late 1980s and early 1990s (Benson and Ponton, 1993). In order to

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