ABSTRACT

THE Analyst

www.rsc.org/analyst

Electric field-induced mobilisation of multiphase solution systems based on the nitration of benzene in a micro reactor

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Received 19th September 2000, Accepted 27th October 2000
First published as an Advance Article on the web 19th December 2000

This paper describes the electric field-induced flow characteristics of multiphase solutions in a micro reactor device using the nitration of benzene as a model process. Photolithographic and wet etching techniques were used to fabricate the micro reactor (channels, 200 μm id, 100 μm deep) in a borosilicate glass substrate. The results focus specifically on the flow parameters of reagents/reactants (*i.e.*, voltage, solution concentration and pH ranges and current–voltage relationships) used in this study. The benzene was introduced and mobilised by electroosmotic flow (EOF), as a microemulsion using an appropriate surfactant (sodium dodecyl sulfate), whilst the nitronium ions, produced *in situ* from mixed H_2SO_4–HNO_3 (the nitrating agent), underwent electrophoretic-induced (electrokinetic) mobility. A co-surfactant, butan-1-ol, was used owing to (a) its relative solubility in the aqueous surfactant solution, (b) its ability to aid the solubilization of benzene, (c) the provision of a water-rich (oil-in-water) rather than oil-rich (water-in-oil) microemulsion system and (d) its lack of significant adverse effects on the EOF. The optimum conditions used for the nitration of benzene within the micro reactor were a run of the microemulsion as main reagent stream, then three 30 s segmented injections of mixed acid, with a 5 s push of the microemulsion into the system after each injection, and then a 60 s stopped-flow reaction time before driving reaction product segments to a collection reservoir.

Analyst, 2001, **126**, 14–20