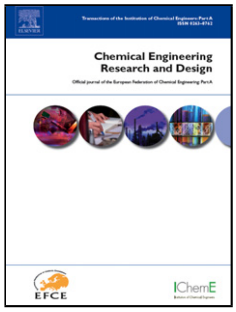

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Author: S. Mhatre V. Vivacqua M. Ghadiri A.M. Abdullah M.J. Al-Marri A. Hassanpour B. Hewakandamby B. Azzopardi B. Kermani

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Electrostatic Phase Separation: A Review

S. Mhatre[1], V. Vivacqua[1], M. Ghadiri[2*], A. M. Abdullah[1], M. J. Al-Marri[3], A. Hassanpour[2], B. Hewakandamby[4], B. Azzopardi[4], B. Kermani[5]

[1] Center for Advanced Materials, Qatar University, Doha 2713, Qatar
[2] Institute for Particle Science and Engineering, University of Leeds, Leeds LS2 9JT, UK
[3] Gas Processing Center, Qatar University, Doha 2713, Qatar
[4] Department of Chemical and Environmental Engineering, University of Nottingham, Nottingham NG7 2RD, UK
[5] Keytech, Camberley GU15 2BN, UK

* Corresponding author: m.ghadiri@leeds.ac.uk (Mojtaba Ghadiri)
Tel.: +44-0113-233-2406
fax: +44-0113-233-2405

Abstract

The current understanding and developments in the electrostatic phase separation are reviewed. The literature covers predominantly two immiscible and inter-dispersed liquids following the last review on the topic some 15 years. Electrocoalescence kinetics and governing parameters, such as the applied field, liquid properties, drop shape and flow, are considered. The unfavorable effects, such as chain formation and partial coalescence, are discussed in detail. Moreover, the prospects of microfluidics platforms, non-uniform fields, coalescence on the dielectric surfaces to enhance the electrocoalescence rate are also considered. In addition to the electrocoalescence in water-in-oil emulsions the research in oil-in-oil coalescence is also discussed. Finally the studies in electrocoalescer development and commercial devices are also surveyed.

The analysis of the literature reveals that the use of pulsed DC and AC electric fields is preferred over constant DC fields for efficient coalescence; but the selection of the optimum field frequency a priori is still not possible and requires further research. Some recent studies have helped to clarify important aspects of the process such as partial coalescence and drop-drop non-coalescence. On the other hand, some key phenomena such as thin film breakup and chain formation are still unclear. Some designs of inline electrocoalescers have recently been proposed; however with limited success: the inadequate knowledge of the underlying physics still prevents this technology from leaving the realm of empiricism and fully developing in one based on rigorous scientific methodology.

Nomenclature