A fast and accurate Langmuir-type polymer microtensiometer

Pieter Gijsenbergh, Jan Vermant, Robert Puers

PII: S0001-8686(17)30018-0
DOI: doi: 10.1016/j.cis.2017.08.007
Reference: CIS 1825

To appear in: *Advances in Colloid and Interface Science*

Received date: 15 January 2017
Revised date: 22 August 2017
Accepted date: 30 August 2017

Please cite this article as: Gijsenbergh Pieter, Vermant Jan, Puers Robert, A fast and accurate Langmuir-type polymer microtensiometer, *Advances in Colloid and Interface Science* (2017), doi: 10.1016/j.cis.2017.08.007

A fast and accurate Langmuir-type polymer microtensiometer

Pieter Gijsenbergh[a,*], Jan Vermant[b], and Robert Puers[a]

[a] *KU Leuven ESAT-MICAS, Leuven, Belgium*
[b] *ETH Zürich, Department of Materials, Zürich, Switzerland*

Abstract

A semi-flexible polymer microtensiometer for local surface pressure measurements of Langmuir monolayers is presented. The current device geometry and read-out method via image analysis result in a theoretical accuracy of ± 0.02 mN·m^{-1} for a dynamic range between 0 and 75 mN·m^{-1}. The tensiometer sensitivity and dynamic range are easily tunable as they are solely based on the tensiometer spring dimensions. Finite element simulations are used to determine the response time of 20 ms for a subphase viscosity of 1 mPa·s. A poroviscomechanical model of the sensor is composed and the subphase viscosity is shown to dominate the transient behaviour. The tensiometer performance is verified in a Langmuir trough by applying rapid local surface pressure oscillations. A Wilhelmy plate is used as an independent measurement tool and the results of both techniques correlate well.

Keywords: Tensiometry, Surface tension, Interfacial tension, Surface pressure, Response time, Dynamic range, Viscosity

1. Introduction

Surface tension shapes the world around us. It is the physical property that gives a fluid surface an elastic nature and causes it to minimize its surface area. Among many other things, surface tension is responsible for the shape and size of rain drops and insects walking on water. When two immiscible fluids are brought in contact (e.g. oil and water), the term interfacial

*Pieter Gijsenbergh - Kasteelpark Arenberg 10, B-3001, Leuven, Belgium - Tel: +32 16 325629 - Fax: +32 16 321975 - pietergijsenbergh@gmail.com