# Rheo-PIV of Shear Banding Wormlike Micelles under LAOS

**L. Casanellas*, C. Dimitriou†, T. Ober†, G. H. McKinley†**
* Departament d'Estructura i Constituents de la Matèria,
Universitat de Barcelona, C. Martí Franquès 1, 08028 Barcelona, Spain
e-mail: laurac@ecm.ub.es

†Department of Mechanical Engineering
Massachusetts Institute of Technology
77 Massachusetts Ave, Cambridge, MA 02139, USA

## ABSTRACT

In this work we experimentally investigate the shear banding phenomena in wormlike micellar solutions, CPyCl–NaSal [100:60]mM [1], under oscillatory and steady shear, using a RheoPIV system. This device incorporates a Particle Image Visualization technique (PIV) into a cone-plate rheometer so that it simultaneously provides rheological data and local velocity fields in the sample. At low shear rates, compared to the fluid relaxation time (Wi $< 1$), the fluid response is linear and well described by the viscoelastic Maxwell model. At increasing shear rates (Wi $> 1$) the micellar fluid shows a significant shear-thinning behaviour.

In oscillatory flow, we reach the linear regime performing small amplitude oscillatory shear tests (SAOS), and the non-linear regime applying large amplitude oscillations (LAOS). We are able to distinguish both regimes by means of the measured Lissajous curves. In SAOS experiments, the velocity profiles in the bulk are linear. Conversely, in LAOS tests the velocity profiles show three distinct shear bands distributed along the flow gradient direction. Two low sheared bands are located at the boundaries and a highly sheared band at the center, in agreement with previous observations made by Britton and Callaghan [2]. Even though the shear bands are stable they show outstanding time dependent features. In particular, the position of the highly sheared band oscillates along the vertical direction with the frequency of the driving, while its width slightly varies around a fixed value. In steady shear we obtain similar trends for the measured velocity profiles with linear velocity profiles at low Wi and three banded profiles for Wi $> 1$. However, in this case, the highly sheared band is steady in time, and it has a very thin width. In both oscillatory and steady flow, the shear band formation in the bulk is accompanied by slip on the surfaces. The interplay between these two nonlinear effects depends on the roughness of the surfaces, as described by Lettinga and Manneville [3], and makes the understanding of the shear band formation more complex.

## REFERENCES

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