EFFECTS OF CHANNEL LENGTH IN EXPANSION PARTS ON FLOW REGIMES OF POLYMER SOLUTION IN CONSECUTIVE ABRUPT CONTRACTION-EXPANSION CHANNELS

Ruri Hidema[1], Yuta Nakamura[1], Francois Lequeux[2] and Hiroshi Suzuki[1]

[1]Kobe University, Kobe, Japan
[2]ESPCI Paris, Paris, France

ABSTRACT

Elastic instability of viscoelastic fluids in microfluidic devices have received lots of attention for the last two decades. Flow regimes of viscoelastic fluids in an abrupt contraction-expansion channel were especially intensively studied, because the channel geometry is related to a flow used in many industrial applications[1]. Reynold number, *Re* [-], and Weissenberg number, *Wi* [-] are usually useful to characterize flow regimes in the channels. However, in the case of the micro channels that consist of consecutive contraction-expansion units mimicking a porous media, variations of flow regimes are affected by other factors in addition to *Re* and *Wi*. For instance, various flow regimes of polymer solution in the same consecutive contraction-expansion channels developed from the inlet to the outlet. In such cases, both polymer deformation-relaxation process and scission of polymers are the key to understand the development in the channel[1, 2]. In this study, we aim to quantify the relative effects of memories of polymer deformation-relaxation and scission of polymers on the flow regimes of polymer solution. We prepared several consecutive abrupt contraction-expansion channels that have different lengths of the expansion part. The channel geometries affect Henky strain and extensional rates in each contraction-expansion unit, which govern the flow development of polymer solutions.

ACKNOWLEDGEMENTS

This study was supported in part by the Japan Science and Technology Agency (JST) FOREST Program (Grant Number JPMJFR203O, Japan).

REFERENCES

1. Hidema, R.; Oka, T.; Komoda, Y.; Suzuki, H. Effects of flexibility and entanglement of sodium hyaluronate in solutions on the entry flow in micro abrupt contraction-expansion channels. *Phys. Fluids*, **31**, 72005, 2019. https://doi.org/10.1063/1.5096781
2. Garrepally, S.; Jouenne, S.; Olmsted, P.D.; Lequeux, F. Scission of flexible polymers in contraction flow: Predicting the effects of multiple passages. *J. Rheol.*, **64**, 601, 2020. https://doi.org/10.1122/1.5127801