Preface to Special Topic: Papers from the Institute of Non-Newtonian Fluid Mechanics Meeting, Lake Vyrnwy, 2017

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Preface to Special Topic: Papers from the Institute of Non-Newtonian Fluid Mechanics Meeting, Lake Vyrnwy, 2017

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The Institute of Non-Newtonian Fluid Mechanics (INNFM) is an organisation founded in 1991 in Wales to encourage collaborative research in the area of rheology of non-Newtonian fluids. A key role of the INNFM is to bring together active researchers in the field through regular meetings, which over the years has built a rheological community of mathematicians, physicists, chemists, engineers, and computational scientists. The meeting is also the place where long lasting friendships are formed. Although the size of our meetings might be small (around 60 delegates), it attracts some of the most eminent rheologists from all over the world. Our scientific programme has no parallel sessions, and, to that end, all of our invited talks are plenary. The 2017 meeting was held in the idyllic location of Lake Vyrnwy in Llanwddyn, Wales. Lake Vyrnwy is a designated nature reserve and the meeting venue boasts panoramic views of wooded hillsides, the lake, and an iconic neo-Gothic style tower. I should add that this is not the first time the meeting has been held at Lake Vyrnwy—and it is unlikely to be the last!

This special topic represents a selection of the papers presented at the meeting. Upon examining these papers, not only is it apparent that there is a diverse scope of science but also the relevance to a vast range of applications, including foodstuffs, healthcare, automotive parts and machinery, personal care, gels, creams, polymer processing, and microbiology. Historically, one of the core themes of our meetings has been advances in the field of rheometry. The papers presented here include the development of passive non-linear microrheology for measuring the non-equilibrium properties of complex fluids[1] and a method for correcting inertial artefacts in a gel point measurement using combined motor-transducer rheometers.[2] The paper by Lamer *et al.*,[3] describing the use of controlled stress large amplitude oscillatory shear (LAOS) to reveal detailed information of reversible and irreversible structural changes in fibrin clots, received the British Society of Rheology–TA Instruments Award at the meeting for the best student poster as judged by the current president of the Society of Rheology, Professor Gareth McKinley and the immediate past president of the European Society of Rheology, Professor Mats Stading. On the subject of LAOS, Saengow and Giacomin[4] describe exact and unique analytical solutions for both normal stress differences in a LAOS measurement for the Oldroyd 8-constant framework.

Some of the papers presented fit appropriately within the category of applied rheology and combine both experimental and modeling studies. These papers include Lee *et al.*[5] who describe a simulation model to study the helical instability in film blowing processes that closely agrees with experimental findings, whilst Lambert *et al.*[6] report a study of fiber orientation dynamics during the processing of polymer-fiber composites and explore the use of a stress model to fit experimental closure force data based on non-lubricated squeeze flow. Skamniotis *et al.*[7] use the finite element analysis to model food separation patterns under an indentation test which can be used to understand how different food structures breakdown under chewing, whilst Bek *et al.*[8] investigate the use of a patented technology that uses granular materials to enhance material properties by exposure to "self-pressurization."

Papers relating to the development of numerical methods, predictive models, and computational rheology are well represented. Examples include the use of the lattice Boltzmann method to simulate particle migration in a combination of Couette and Poiseuille flows,[9] an improved numerical framework for a broad range of simulations including those of free surface flows and flows with particles,[10] and the development of numerical spectral method with a mechanistic explanation of a model microswimmer in the presence of a solid boundary.[11] López-Aguilar *et al.*[12] introduce a continuous spectrum model to seek agreement between prediction and experiment in contraction-flow pressure drops for Boger fluids, whilst Townsend and Wilson[13] investigate the effect of different frictional contact models to simulate flow of suspensions in order to explore the mechanisms of shear thickening. Vázquez-Quesada and Ellero[14] report advances in a smoothed particle hydrodynamics model for simulation of rigid spheres within a viscoelastic matrix, whilst Evans *et al.*[15] describe stress singularity of different viscoelastic models in steady planar stick-slip flows. It is noteworthy that several of these papers utilise the Oldroyd-B model, a constitutive model formulated by Professor James Oldroyd in 1950, to describe the flow of viscoelastic fluids. Indeed, this has particular relevance to the academic ancestry of the INNFM. The founding member and chairman of the INNFM, Professor Ken Walters FRS, was a student of Oldroyd's. The INNFM, which was formed from off-shoots of Ken Walters' research group, now has 13 core members and around 50 associate members drawn from the worldwide rheological community who share a common goal to collaborate and share knowledge.

On behalf of the INNFM, I wish to take this opportunity to thank each of the authors for their contribution to this special topic. I would like to thank my co-organisers, Professor Rhodri

Williams and Dr. Daniel Curtis, and also Professor Ken Walters for his invaluable guidance and inspiration. I also wish to thank Professor Jeffrey Giacomin for attending the meeting where he gave both a talk and an entertaining after-dinner speech (including a light "roasting" for some!) as well as his generous offer to host this special topic in Physics of Fluids.

[1]K.-W. Hsiao, J. Dinic, Y. Ren, V. Sharma, and C. M. Schroeder, "Passive non-linear microrheology for determining extensional viscosity," Phys. Fluids **29**, 121603 (2017).
[2]R. E. Hudson, A. J. Holder, K. M. Hawkins, P. R. Williams, and D. J. Curtis, "An enhanced rheometer inertia correction procedure (ERIC) for the study of gelling systems using combined motor-transducer rheometers," Phys. Fluids **29**, 121602 (2017).
[3]T. F. Lamer, B. R. Thomas, D. J. Curtis, N. Badiei, P. R. Williams, and K. Hawkins, "The application of large amplitude oscillatory stress in a study of fully formed fibrin clots," Phys. Fluids **29**, 121606 (2017).
[4]C. Saengow and A. J. Giacomin, "Normal stress differences from Oldroyd 8-constant framework: Exact analytical solution for large-amplitude oscillatory shear flow," Phys. Fluids **29**, 121601 (2017).
[5]J. S. Lee, I. Kwon, H. W. Jung, and J. C. Hyun, "Helical instability in film blowing process: Analogy to buckling instability," Phys. Fluids **29**, 121501 (2017).
[6]G. Lambert, P. Wapperom, and D. Baird, "Obtaining short-fiber orientation model parameters using non-lubricated squeeze flow," Phys. Fluids **29**, 121608 (2017).
[7]C. G. Skamniotis, M. Elliott, and M. N. Charalambides, "On modeling the large strain fracture behaviour of soft viscous foods," Phys. Fluids **29**, 121610 (2017).
[8]M. Bek, J. Betjes, B.-S. von Bernstorff, and I. Emr, "Viscoelasticity of new generation thermoplastic polyurethane vibration isolators," Phys. Fluids **29**, 121614 (2017).
[9]B. Chun, I. Kwon, H. W. Jung, and J. C. Hyun, "Lattice Boltzmann simulation of shear-induced particle migration in plane Couette-Poiseuille flow: Local ordering of suspension," Phys. Fluids **29**, 121605 (2017).
[10]K. Yokoi, M. Furuichi, and M. Sakai, "An efficient multi-dimensional implementation of VSIAM3 and its 2 applications to free surface flows," Phys. Fluids **29**, 121611 (2017).
[11]T. R. Ives and A. Morozov, "The mechanism of propulsion of a model microswimmer in a viscoelastic fluid next to a solid boundary," Phys. Fluids **29**, 121612 (2017).
[12]J. E. López-Aguilar, M. F. Webster, H. R. Tamaddon-Jahromi, O. Manero, D. M. Binding, and K. Walters, "On the use of continuous spectrum and discrete-mode differential models to predict contraction-flow pressure drops for Boger fluids," Phys. Fluids **29**, 121613 (2017).
[13]A. K. Townsend and H. J. Wilson, "Frictional shear thickening in suspensions: The effect of rigid asperities," Phys. Fluids **29**, 121607 (2017).
[14]A. Vázquez-Quesada and M. Ellero, "SPH modelling and simulation of spherical particles interacting in a viscoelastic matrix," Phys. Fluids **29**, 121609 (2017).
[15]J. D. Evans, I. L. Palhares, Jr., and C. M. Oishi, "Stresses of PTT, Giesekus and Oldroyd-B fluids in a Newtonian velocity field near the stick-slip singularity," Phys. Fluids **29**, 121604 (2017).