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The effect of normal stress on the rheology of sub-micron thick polymer melt[1] JANET WONG, ALEKS PONJAVIC, Imperial College London
— The rheology of sub-micron thick polymer melt confined and sheared between a sphere and a flat surface (resulting in a circular point contact) is examined by obtaining the local through-thickness flow profiles of the melt. The effect of normal stress exerted to the melt is investigated. The rheology of the melt and the mechanical response of the fluid system are then correlated. The possibility of rheological heterogeneity within the confined melt is also explored. It is observed that behaviour of the confined melt is insensitive to the range of shear rate tested. Normal stress exerted, on the other hand, influences the rheology of the confined melt significantly. A critical normal stress exists below which Couette-like flow profiles are observed. Above the critical normal stress, the flow profiles signify plug-flow. This can be due to pressure-induced polymer glass transition. The existence of a critical stress is confirmed by the variation of local flow profiles within the point contact that closely resembles the normal pressure distribution in the contact. While a switch in flow behaviour occurs at a critical normal stress, the corresponding change in mechanical response in terms of measured friction forces is only marginally.

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