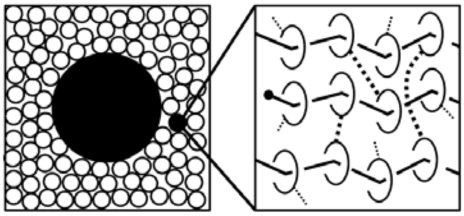

Fig. 1: Multiscale simulation of entangled polymer melt flow. The macroscopic flow is modeled with a fluid particle simulation and the microscopic states of polymers in the fluid elements are described by the slip-link model.

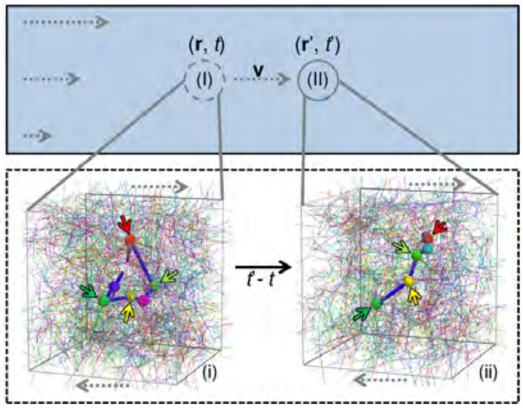

Fig. 2: Macroscopic advection of a fluid element and its microscopic polymer states. While the fluid element moves from (I) to (II), the polymer states changes from (i) to (ii). The microscopic states of polymers depend on the flow history.

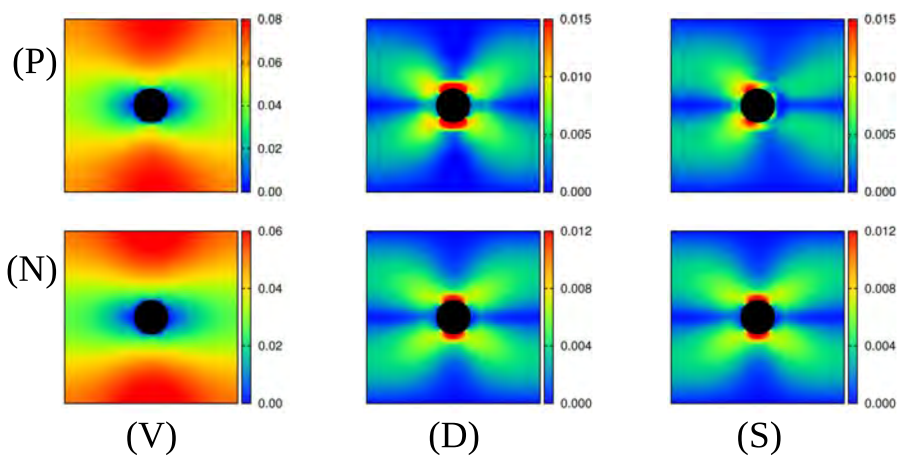

Fig. 3: Entangled polymer melt flow (P) and Newtonian flow (N) around a cylindrical obstacle. The velocity fields (V), the deformation rate fieds (D) and the stress fields (S) of (P) and (N) are shown here. Because the stress of polymer melt is described with the microscopic states of polymers, the stress filed of (P) is clearly asymmetric, namely flow-history-dependent.

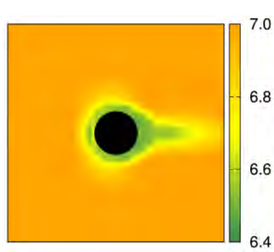

Fig. 4: Macroscopic distribution of microscopic information (entanglement number averaged per a polymer chain). The multiscale simulation enables us to obtain such multiscale information.