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Shear induced gradient diffusivity of red blood cell suspensions
ABHILASH REDDY MALIPEDDI, KAUSIK SARKAR, The George Washington University — We compute the shear-induced gradient-diffusivity of red blood cells (RBC) from direct numerical simulation using a dynamic structure factor approach. Macro-scale phenomena, such as diffusivities, result from the micro-scale dynamics of RBCs. RBCs in shear flow exhibit extremely rich and complex motion such as tank-treading, tumbling and swinging. They affect the shear-induced diffusivity analyzed here. As the shear rate increases, the diffusivity increases initially due to the increased deformability of the cells, and thereby enhanced interactions between them. On further increase of the shear rate, a transition point is reached where the diffusivity briefly decreases before increasing again. The decrease corresponds to the transition of the single cell dynamics from the tumbling regime to the tank-treading regime. During tumbling of an RBC, due to the larger swept volume of the tumbling shape, its effective size and correspondingly the length scale for diffusion is larger than what is indicated by the cell volume. In the tank-treading regime, this effect is absent resulting in lowered diffusivity.

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