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Theory of margination in confined multicomponent suspensions[1]
RAFAEL HENRIQUEZ RIVERA, KUSHAL SINHA, MICHAEL GRAHAM, University of Wisconsin-Madison — In blood flow, leukocytes and platelets tend to segregate near the vessel walls; this is known as margination. Margination of leukocytes and platelets is important in physiological processes, medical diagnostics and drug delivery. A mechanistic theory is developed to describe flow-induced segregation in confined multicomponent suspensions of deformable particles such as blood. The theory captures the essential features of margination by describing it in terms of two key competing processes in these systems at low Reynolds number: wall-induced migration and hydrodynamic pair collisions. The theory also includes the effect of physical properties of the deformable particles and molecular diffusion. Several regimes of segregation are identified, depending on the value of a margination parameter M. Moreover, there is a critical value of M below which a sharp drainage transition occurs: one component is completely depleted from the bulk flow to the vicinity of the walls. Direct hydrodynamic simulations also display this transition in suspensions where the components differ in size or flexibility. The developed mechanistic theory leads to substantial insight into the origins of margination and will help in guiding development of new technologies involving multicomponent suspensions.

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