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Influence of Red Blood Cells on Nanoparticle Targeted Delivery in Microcirculation JIFU TAN, ANTONY THOMAS, YALING LIU, Lehigh University — In this paper, a particle-cell hybrid model is developed to model Nanoparticle (NP) transport, dispersion, and binding dynamics in blood suspension under the influence of Red blood cells(RBCs). The motion and deformation of RBCs is captured through the Immersed Finite Element Method. The motion and adhesion of individual NPs are tracked through Brownian adhesion dynamics. A mapping algorithm and an interaction potential function are introduced to consider the cell-particle collision. NP dispersion and binding rates are derived from the developed model under various rheology conditions. The influence of RBCs, vascular flow rate, and particle size on NP distribution and delivery efficacy is characterized. A non-uniform NP distribution profile with higher particle concentration near the vessel wall is observed. Such distribution leads to over 50% higher particle binding rate compared to the case without RBC considered. The tumbling motion of RBCs in the core region of the capillary is found to enhance NP dispersion, with dispersion rate increases as shear rate increases. Results from this study contribute to the fundamental understanding and knowledge on how the particulate nature of blood influences NP delivery, which will provide mechanistic insights on the nanomedicine design for targeted drug delivery applications.

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