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Hydrodynamic Torques and Rotations of Superparamagnetic Bead Dimers CHRISTOPHER PEASE, J. ETHERIDGE, H.S. WIJESINGHE, C.J. PIERCE, M.V. PRIKOCKIS, R. SOORYAKUMAR, The Ohio State University — Chains of micro-magnetic particles are often rotated with external magnetic fields for many lab-on-a-chip technologies such as transporting beads or mixing fluids. These applications benefit from faster responses of the actuated particles. In a rotating magnetic field, the magnetization of superparamagnetic beads, created from embedded magnetic nano-particles within a polymer matrix, is largely characterized by induced dipoles m_{ip} along the direction of the field. In addition there is often a weak dipole m_{op} that orients out-of-phase with the external rotating field. On a two-bead dimer, the simplest chain of beads, m_{op} contributes a torque Γ_m in addition to the torque from m_{ip}. For dimers with beads unbound to each other, m_{op} rotates individual beads which generate an additional hydrodynamic torque on the dimer. Whereas, m_{op} directly torques bound dimers. Our results show that Γ_m significantly alters the average frequency-dependent dimer rotation rate for both bound and unbound monomers and, when m_{op} exceeds a critical value, increases the maximum dimer rotation frequency. Models that include magnetic and hydrodynamics torques provide good agreement with the experimental findings over a range of field frequencies.

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