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Harnessing low Reynolds number flow for net migration: Locomotion of a deformable microcapsule by random fluid forces[1] TAKUJI ISHIKAWA, TAKERU MORITA, TOSHIHIRO OMORI, YOHEI NAKAYAMA, SHOICHI TOYABE, Tohoku University — Random noise in low Reynolds number flow has rarely been used to obtain net migration of microscale objects. In this paper, we show that net migration of a microscale object can be extracted from random directional fluid forces, by introducing deformability and inhomogeneous density into the object. As a model system, we considered an elastic microcapsule containing fluid and a rigid sphere with different densities. The numerical results showed that the microcapsule could migrate vertically downward when random forces were applied using a migration mechanism based on non-reciprocal body deformation in Stokes flow. We also developed a mathematical framework to describe the deformation-induced migration caused by noise. The proposed theory showed good agreement with the simulation results, and illustrated that drag asymmetry acts like a rachet to generate net downward motion under noise. These results provide a basis for understanding the noise-induced migration of a micro-swimmer and are useful for harnessing energy from low Reynolds number flow.

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