Collective motion of Nafion-based micromotors in water

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Ion exchange is one of the most interesting processes occurring at the interface between aqueous solutions and polymers, such as the well-known Nafion. If the exchanged ions have different diffusion coefficients, this interchange generates local electric fields which can be harnessed to drive fluid motion. In this work, we show how it is possible to design and fabricate self-propelling microswimmers based on Nafion, driven by ion-exchange, and fueled by innocuous salts. These Nafion micromotors are made using colloidal lithography by micro/nanostructuring Nafion in the form of asymmetric rods. These microswimmers exhibit fascinating collective motion in water driven by the interplay of their self-generated chemical/electric fields and their capability to pump matter nearby towards the collective motile structure. The pumping activity of the microswimmers induces the formation of growing mobile clusters, whose velocity increases with size. Such dynamic structures are able to trap nearby micro/nano-objects while purifying the liquid, which acts both as the transport media and as fuel. Such phenomenology opens the door to potential applications in water remediation that are currently under development.

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