



Light-driven micromotors for on-demand and local pH sensing applications

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Abstract

In recent years, self-propelled light-driven micromotors have gained significant attention due to their capabilities for a wide range of applications, including, cargo delivery, chemical sensing, environmental monitoring, etc. Here, we demonstrate the design of light-driven micromotors for local pH sensing applications. The micromotors are spherical Janus particles with multiple functional coatings that provide them interesting features, like, a dual optical response i.e., controlled swimming under UV light (320-400nm) and pH-dependent fluorescence signal emission when excited with blue light (450 nm) and moving path guidance using the weak external uniform magnetic field (50 G). All these features allow the micromotors to sense the pH of the medium on-demand and locally or of a target location by guiding them to swim to the target location. The pH-dependent change in the fluorescent signal intensity is used for the measurement of the local pH of the medium. It is observed that the careful measurement of small pH changes requires a spectrometer that precisely measures the intensity change. However, the fluorescence signal of micromotors was good enough to provide a clear visual demarcation for large pH changes. Systematic experimental studies supported by controlled experiments are performed to optimize the system as well as to calibrate the micromotors for local pH sensing applications. The characteristics like easy-to-design structure, light activation, directional swimming, and ability to measure the pH on-demand and locally prove that micromotors have the potential to revolutionize pH monitoring in various domains including lab-on-a-chip devices, biomedical research, environmental monitoring, and quality control in industrial processes, etc.

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