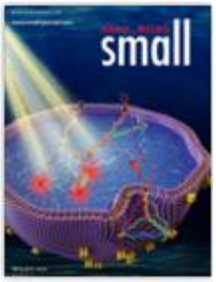

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Light-Induced Motion of Microengines Based on Microarrays of TiO2 Nanotubes

Enachi Mihail, Guix Maria, Postolache Vitalie, Ciobanu Vladimir, Fomin Vladimir M., Schmidt Oliver G., Tiginyanu Ion

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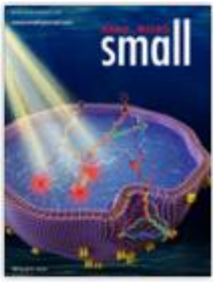
Abstract

An electrochemical approach for manufacturing light-driven nanostructured titanium dioxide (TiO_2) microengines with controlled spatial architecture for improved performance is reported. The microengines based on microscale arrays of TiO_2 nanotubes with variable (50–120 nm) inner diameter show a quasi-ordered arrangement of nanotubes, being the smallest tubular entities for catalytic microengines reported to date. The nanotubes exhibit well defined crystalline phases depending upon the postfabrication annealing conditions that determine the microengines' efficiency. When exposed to UV-light, the microarrays of TiO_2 nanotubes exhibiting conical internal shapes show directed motion in confined space, both in the presence and absence of hydrogen peroxide. In the former case, two different motion patterns related to diffusiophoresis and localized nanobubble generation inside of the tubes due to the photocatalytic decomposition of H_2O_2 are disclosed. Controlled pick-up, transport, and release of individual and agglomerated particles are demonstrated using the UV light irradiation of microengines. The obtained results show that light-driven microengines based on microarrays of TiO_2 nanotubes represent a promising platform for



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controlled micro/nanoscale sample transportation in fluids as well as for environmental applications, in particular, for the enhanced photocatalytic degradation of organic pollutants due to the improved intermixing taking place during the motion of TiO2 microengines.