Lipase-powered mesoporous silica nanoparticles for triglyceride degradation

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Abstract
The development of synthetic nanomotors for technological applications for life science or nanomedicine is a key focus of current basic research. Enzyme-powered nanomotors offer more advantages, due to their biocompatible and biomimetic properties, capable of actuating in biological systems without side effects[1,2]. Herein, we not only explored another enzyme to the library of biocatalysts with the ability to power motor motion, but also shows an enzymatic motor that retains activity in organic solutions, degrading the triglyceride [3]. The biofriendly propulsion of lipase powered MSNs was realized through the biocatalytic reaction of lipase and its representative water-soluble substrate (triacetin as fuel), exhibiting the enhanced motion (i.e., ~50% increase of diffusion coefficient, Figure 1) at low triacetin concentration (e.g. < 10 mM) compared to Brownian motion, with the lifetime of ~40 min. Particularly, lipase here not only served as the power engine, but also functionalized as a cleaner for the lipid globules (e.g. tributyrin) in PBS solution, which offered a potential tool for dealing with the lipid storage diseases in the biomedical fields.

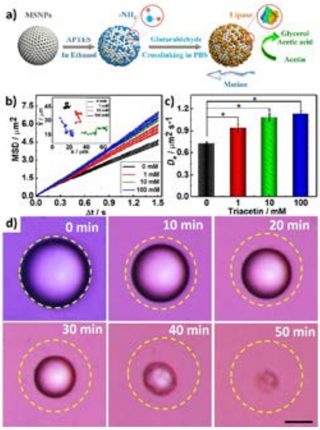

Figure 1. (a) Schematic representation of the functionalization strategy for the preparation of the lipase-based nanomotors whose motion was triggered by catalytic reaction with triacetin. (b) Representative trajectories (inset) of LNMs with different triacetin concentrations of 0 mM (black), 1 mM (red), 10 mM (green), and 100 mM (blue) and corresponding mean-squared displacements (MSD) (n ≥ 20, error bars represent SE); c) effective diffusion coefficients obtained by analysing the MSD for different triacetin concentrations; d) The colour change of the surrounding medium is caused by the litmus indicating the continuous generation of butyric acid. Round dashed circles indicate the initial size of the tributyrin droplets. The scale bar is 5 μm.

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